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Photo by Fred W. Lahrman, Regina

Keep the Whooping Crane Flying

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SASKATCHEWAN DEPARTMENT OF THE ENVIRONMENT

Governing bodies, recognizing that there is an environmental crisis, are beginning to show in concrete ways that they intend to do what they can to monitor the amount of pollution, and possibly even do something to delay or even reverse the trend to deterioration. On this page in the June *Blue Jay* I commented on the Stockholm Conference, the first United Nations conference on environmental problems. Time will tell whether or not that conference was a success.

In Saskatchewan, on May 12 of this year, our government created a Department of the Environment in recognition of "legitimate" public concern about preservation of the environment in which we all live and work. As a fitting first activity the Minister and the Deputy Minister of the Department went to Stockholm and returned to our province after the conference aware of the difficulties of their respective assignments and resolved to do their best to prevent further deterioration of the human environment.

On August 2 your editor was kindly granted an interview with Mr. Neil E. Byers, Minister of the new Department of the Environment. Mr. Byers seemed interested in our society, and at the end of the meeting we both expressed the hope that this was but the first of many mutually profitable meetings which may take place between representatives of our respective groups.

The Department of the Environment as presently set up has three subdivisions. One is the Environmental Protection Service, which is subdivided again into an air pollution control branch, water pollution control branch, and the land protection service. The second is the Policy, Planning and Research Branch. The third is the Water Management Service.

The Minister explained that his department will set standards and that it will then be the responsibility of various other departments of the government to see that their activities do not result in levels of pollution greater than the maximum. This interrelationship between departments has resulted in the setting up of an Interagency Co-ordinating Committee which will review environmental management policies and develop guidelines for field administration of environmental control regulations. There will also be a 12-member Environmental Advisory Council whose members are representatives of major interest groups. Because SNHS may be represented on this council, we should surely hear more of the activities of this group. The Minister said that his department is anxious to have public hearings and seminars and that it will welcome public participation in decision-making in environmental matters. The formation of an active public information and educational service within the department encourages me to think that the government is prepared to give some leadership in the recognition and correction of environmental problems.

I do not mean to imply from this that we can now relax and leave the health of Saskatchewan environments to the Government. The Department was formed only because of public demand and it will do a good job only if the public remains concerned. However, we now can send letters and resolutions to the Department of the Environment and expect that the personnel of the Department will read our submissions with sympathy and understanding. If, for example, you have a problem which relates to environment and natural resources, you should write to the appropriate person in the Department of Natural Resources and at the same time send copies to the Department of the Environment and to SNHS. We anticipate that every worthy letter will get action.

It is obvious that each of us must accept more responsibility now that there are increasing indications that environment is becoming overwhelmed by man. We must become better informed; we must try to understand the diversity and the interrelationships which make for a fairly stable and healthy environment. When we see wrongs done against nature, we must report those wrongs, and we must do our best to see that the wrong doer repairs the damage or is punished. We hope that the new Department of the Environment will merit the approval of all those who are committed to preserving what remains of the natural environment of the province.

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COYOTE MANAGEMENT IN SASKATCHEWAN: IS POISON THE ANSWER?

by **Nora M. Stewart**, R.R. #2, Craven

The dog vomited, writhed, ran blindly into walls, convulsed, and, after about 20 minutes of agony, lay still. He had been a companion, house guard, and hunting dog, friendly and harmless, but now he was dead. Why and how, especially here in the Qu'Appelle Valley, a mile from the nearest neighbour? Could it be that poison bait was being put out "legitimately" to control coyotes, or did someone deliberately poison our dog? As we began asking questions of neighbours, municipal officials, police, and Department of Natural Resources (DNR) personnel, it became apparent that legal aspects of poisoning were poorly defined, and scientific ones misunderstood. Although it was obvious that we were going to get no satisfactory answer as to how our dog died, I felt compelled to investigate further, and to write the following article summarizing my findings.

Late in the fall, on the decision of municipal councils and with the written permission of landowners, poison bait is set out in various parts of Saskatchewan to control coyotes (and wolves). Warning signs are placed nearby, and notices of the locations are placed in the local newspapers. DNR provides the poison, equipment and manpower, warning posters, and landowner agreement forms; does the paper work involved in keeping track of bait handling; and pays conservation officers' expenses. The municipality pays for the acquisition of meat for bait (usually a horse or sheep); for handling baits, including cutting up, distributing in late fall, and destroying in spring; and advertising bait locations. To my knowledge, no one has provided a figure for the annual cost to the taxpayer. Even if a figure were available, it would have to be examined closely, because such figures often exclude overhead costs, and these can far exceed the "obvious" expenses.

The poison available to the municipalities is compound 1080, sodium monofluoroacetate. In describing it, United States Senator Gaylord Nelson (1970) of Wisconsin, introducing a bill to establish a national policy with respect to predatory wild animals, says: "1080 is a slow degrading poison that attacks the central nervous system. A coyote, or an animal of similar size, like a dog, can be killed by a dose of 1.4 ounces of treated bait. After eating the poisoned bait, an animal may feel nothing for about thirty minutes, but it will ordinarily die within a few hours, after violent convulsions and vomiting. Because it keeps on moving, the dying animal often vomits deadly bits of undigested meat over a wide area—forming new bait for birds and other animals." This evidence is confirmed by Smelser (1959) in her article which strongly condemns the use of 1080 in the United States.

In the Saskatchewan DNR information booklet "Coyote Control Program 1968-69" (which is not to be made available to the general public—I was told it might cause unnecessary alarm), the figure of 3 oz. of bait to kill a coyote is given, but even this is less than one-quarter cupful. The poison is so toxic that those handling it are advised not to leave bait where it might thaw and drip (en route to its placement destination), because animals such as dogs and cats licking these spots "will in all likelihood die from the effects of the poison."

The poison acquired its name because it was the 1080th experiment undertaken in a Denver, Colorado laboratory to produce an efficient rodenticide. This is stated in DNR's own Coyote Control booklet, and yet three different officials at DNR have told me that 1080 is a selective poison for canines. Actually, the list of victim species is endless. Phillips (1971), lists ferrets, foxes, wolverines, hawks, owls, eagles, mountain lions, bobcats, prairie dogs, skunks, badgers and porcupines. Smelser (1959) adds mink and marten. Perry (1970) quotes a retired trapper who observed magpies, Canada jays, Clark's Nutcrackers, and woodpeckers feeding on 1080 bait stations and "these can carry pieces off and pack it away where weasels can find it."

Another misconception about 1080 which I heard from several people involved in the poison program here is that 1080 has very limited secondary effects; that is, that other creatures eating poisoned animals would not be affected. The DNR information booklet itself notes secondary effects on dogs, cats, rodents, pigs, and carnivorous wild animals, and hence stresses the need for the collection of "all surface kill that can be located"—but of course most animals could run or wander miles from the bait and never be discovered (Smelser, 1959; Phillips, 1971). Perry (1970) quotes the Western Montana Scientists Committee for Public Information: "As 1080 remains stable and does not degrade easily, it is extremely hazardous to animals higher in the food chain." Foxes, skunks, coyotes, eagles, ravens, magpies and jays have died of secondary poisoning. Nelson (1970) refers to this effect as a biological chain reaction and his list includes hawks.

1080 is very soluble in water and does not break down with heat until 200°C is reached. Consequently, the poison is readily leached from the bait during spring thaws and is carried into the surrounding water. Perry (1970) queries, "How much 1080 is washed, during heavy rains, into our streams and absorbed by the root systems of our grasses?" (and hence into our livestock). And Cole, (1971), "What will be the ultimate effects on soil, vegetation and fauna from distributing the relatively stable and deadly 1080 throughout the [western United States] desert?" Perry (1970), in pressing a representative of a U.S. 1080 manufacturing company, received the answer: Yes, it was theoretically possible that "1080 could accidentally leak into public water supplies and cause depressions, convulsions and deaths attributable to heart attacks and that no one would know the cause." And yet, when I objected to the Public Health Department because a bait station was to be set up one-quarter mile from our house, I was told that there was no cause for concern.

1080 is tasteless, odorless, and is given the "most toxic" rating in "Clinical toxicology of commercial products" (Huxtable 1971). The dose for 100 per cent mortality in humans is variously quoted from 2 mg./kg. body weight (Smelser, 1959) to 5 ml./kg. (Huxtable, 1971). Using 2 mg./kg., a 30-pound child eating two pounds of bait poisoned at the rate of 1.4 gm. 1080 per 100 lb. meat would die. This ingestion is unlikely, of course, but possibly children are more sensitive than this figure for an average human would indicate (for cats and dogs the legal dose is only 0.1mg./kg.). In addition, since the poison is not uniformly distributed in the meat (it is injected), it is possible that a small fraction of this amount could kill a child who happened upon one of these bait stations. I have neglected here the possibility of human error in dissolving the poison initially and this must have been a factor in at least some of the 16 confirmed human deaths caused by 1080 by 1956 (Smelser, 1959) or several dozen by 1971 (Huxtable). Nor is it a painless death. One man suffered for 17 hours and there is no known antidote (Smelser).

Does the amount of poisoning being done in Saskatchewan merit concern? Certainly, the number of baits set now is reduced considerably from the time when coyotes were prevalent in the late 1950's. But as late as the winter of 1967-68, 89 municipalities and six local improvement districts set baits. Since then, according to Mr. W. A. Hartwell, the acting Deputy Minister of Natural Resources at the time, the number of baits has been "substantially reduced in the frontier and northern areas, whereas the coverage in the south and particularly the southwest has remained at about the same level" (pers. corres. 1971). In the winter of 1970-71, 38 municipalities set out poison, as many as 10 bait stations per municipality.

Are these stations necessary, and are the restrictions on the use of 1080 stringent enough? According to Mr. Hartwell, the bait placement is made as a result of specific agricultural damage complaints, but in reality the poison is available to any municipality requesting it, apparently without proof of damage. In one case, a station was set up near Regina, adjacent to a game preserve, because a farmer lost "a few chickens." If the poison program is going to continue, surely it is not too much to ask that the use be restricted to cases of excessive economic loss due to confirmed predation by coyotes. In view of 1080's danger, it is probably far cheaper to repay all farmer losses from the public purse than to subject the public to this hazard. This method was advocated by Arizona Rep. Morris Udall in a bill he introduced in the United States to provide coyote protection. The farmer alone should not pay the costs — if there are costs (see below) — of maintaining the coyote.

Also, although bait locations are advertised, many people are not aware that poison is present in their locality. It is my contention that all families within a two-mile radius of a proposed bait station should be warned that it will be set. In addition, I feel that such stations should be banned near urban areas, game preserves, and parks where families may take outings with children or dogs.

Even if restrictions were to be tightened, a major problem that cannot yet be overcome is the veritable impossibility of diagnosing a death due to 1080 (Olson, 1971, pt. 1). In describing to people familiar with poisoning the symptoms that our dog showed, I received about equal guesses of strychnine and 1080. Analysis of vomited bait revealed nothing. Thus it is possible for anyone who dislikes coyotes or dogs to obtain strychnine from their municipality (for gopher control) or even poisoned grain (for rats), use this in conjunction with meat and have the resulting deaths blamed on 1080 bait. This use of the poison is *illegal* but because 1080 is being used with DNR sanction the other can be set out with little fear of detection or consequence, and I suspect that many farmers and others are sure it is allowable. Until the use of 1080 is stopped, it will not be possible to have other instances of poisoning taken seriously by law enforcement agencies, or even DNR officers.

The Pest Control Products Act (Canada) allows for the "treatment of any control product to facilitate its recognition by change in coloration or other means." However, Hon. H. A. Olson, Federal Minister of Agriculture, states that "as yet there is no satisfactory tracer dye that shows up in a bird or animal that has eaten poisoned bait" (pers. corres. 1972). Thus, confirmed diagnosis is limited to rare cases when an expert analyzes the stomach contents very shortly after death. Diagnosis of secondary poisoning is not possible. It remains impossible to assess the extent of killing by this poison.

To try to determine whether, in spite of the disadvantages of 1080, poisoning should be continued, let us now try to assess the value of the coyote. Certainly, the aesthetic appeal of the coyote is considerable. How many visiting campers leave disappointed, having come west expecting to share the pleasure expressed by Ernest Thompson Seton (*in* Young, 1951): "If ever the day should come when one may camp in the West, and hear not a note of the coyote's joyous stirring evening song, I hope that I shall long before have passed away, gone over the Great Divide." Frequently, visiting relatives and numerous schoolchildren who have tented near our home expressed regret after listening intently, and in vain. For my family, a recent northern holiday was made more memorable when coyotes seemed

Photo by Robert R. Taylor, Winnipeg

Coyote — running

to ring our campsite and provide a lively serenade in stereo. The tourist appeal is recognized in Ontario's Algonquin Park, where people line up to hear wolves howl. Naturalists and conservationists appreciate the excitement engendered by the sight and sound of a coyote and this positive feature should not be overlooked by government departments.

The coyote's long-haired pelt is presently in strong demand. Both the 1969 and 1970 annual reports of DNR call coyotes lucrative species. The dollar values for the last four years are given in Table 1. Those taken in the 1970-71 season represent 9.4 percent of the total fur harvest, and 88 percent of them were from the southern region. Trapping in the south is often done by farmers and farmers' sons. Surely this amount of income is a significant advantage in these rural areas. Also, the 1969-70 pelt value was only 50 cents less than that of the beaver which is a vigorously protected species. It should be noted that the government earns a royalty of 50 cents per coyote pelt, a total of some $5,100 in the 1970-71 season.

For further evaluation of the coyote's worth, it is necessary to try to understand its ecological position. Many of the quoted figures concerning the food of coyotes are based on a study by C. C. Sperry for the United States Fish and Wildlife Service (*in* Young, 1951). Between 1931 and 1935, in all seasons and in 17 western and midwestern states, stomach contents were examined from more than 8,000 coyotes. The results showed that rabbits were the most important food, occurring in 43 per cent of the stomachs, except in mid-winter when carrion was most common. Rodents appeared in one-third of the stomachs, livestock in one-fifth. On a volume of

Table 1. Number and value of Coyote pelts taken in Saskatchewan during the last four winters.

Winter	Pelt value	No. taken	Total value
1970-71	$11.97	10,225	$122,377.00
1969-70	12.35	8,316	114,313.05
1968-69	14.16	9,874	136,633.66
1967-68	7.67	3,294	24,429.16

stomach content basis, rabbits constituted 33 per cent, carrion 25 per cent, rodents 17.5 per cent, livestock 13.5 per cent (mainly sheep and goat), deer 3.5 per cent (some of this may have been carrion) and birds (including poultry) 3 per cent. A list of food items of the coyote would include: carrion, lizards, toads, snakes, sheep, calves, pigs, deer, young elk, mountain sheep, grouse, quail, pheasants, ducks, turkeys, chickens, meadowlarks, other song birds, fruit and insect-eating birds, beaver, sage grouse, birds' eggs, wild and domestic fruits, prairie dogs, pocket gophers, ground squirrels, rabbits, field mice, porcupine, grasshoppers and beetles. The pamphlet "Wolves and coyotes of Ontario" (Ontario Department of Lands and Forests) calls the prey of the coyote "anything that is edible, either vegetable or animal", and notes that in that province rabbits, rodents, and small birds are the principal foods. A study in British Columbia in 1947 by J. A. Munro (*in* Young, 1951) noted the eating of a large amount of vegetable matter, but named the rabbit as principal food.

Stomach analysis alone must be viewed with some suspicion, however, because what a coyote eats is not necessarily equivalent to what it destroys. It is a clever animal, quick to take advantage of unusual situations. One example of its cleverness is its habit of following fence lines, picking up the dead grouse which have collided with fence wires. Coyotes also watch for magpies on colts and fawns because this may indicate that the birds are picking up ticks which sometimes paralyze their hosts (Dobie, 1949).

Keeping all these forms of feeding in mind, we can ask what, then, is the overall harm or benefit of the coyote as a species. A difficult question to answer, certainly, but in attempting to do so, I shall consider some of the effects of the animal on carrion, game animals, rodents, insects, and livestock.

Its carrion-eating habits are generally beneficial. Dr. E. R. Hall (*in* Van Wormer, 1964) states: "He (the coyote) is a health officer among game and other animals, including man himself. For one thing, he is a scavenger, and on watersheds which supply water for domestic use, he retrieves many a carcass for food that otherwise would decay and contaminate the water supply, or serve as a lure to filth-loving insects which carry the organisms of decay to man's food."

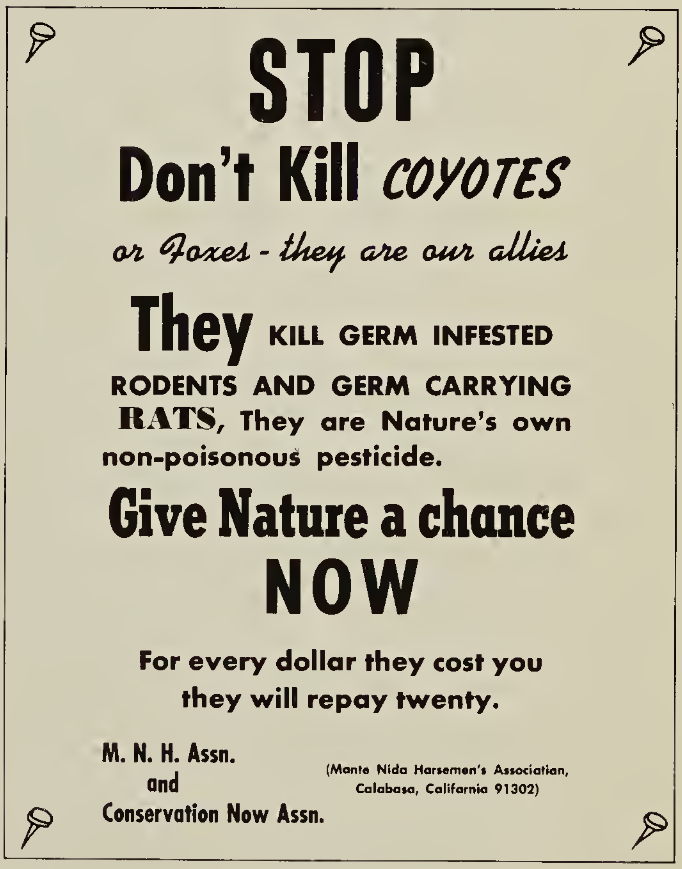
With respect to game animals, predation helps to maintain the quality of prey species by cropping the weak, disabled and diseased (Nelson, 1970; Perry, 1970; Ont. Dept. Lands and Forests). Without this natural control, deer, elk and moose may increase to levels beyond the capacity of the habitat to support them, in which case habitat destruction and starvation result (Nelson, 1970; Olson, 1971). Except in deep, crusty snow or under special conditions such as the migration of antelope across the South Saskatchewan River (Young, 1951), it would seem that healthy game animals are difficult prey for coyotes. For one thing, coyotes usually hunt alone or in pairs, rather than in packs (Young, 1951; Ont. Dept. Lands and Forests), and deer and antelope are often able to outrun them (Van Wormer, 1964). Also, deer have even been known to chase coyotes and stamp on them (Young, 1951). The Ontario goverment publication states that there are no authentic reports of coyotes attacking deer in that province. It is possible that a significant proportion of the stomach content evidence of deer predation represents animals that were near death, due to sickness or injury (eg. by hunters or automobiles). Mr. Hartwell (pers. corres., 1971) stated that baits are not needed for predators of natural wildlife species (i.e. deer) in Saskatchewan.

Coyotes prey on several pests, such as mice, rats, and insects, and although Young (1951) suggests that this probably does little to prevent plagues of these animals, others strongly stress the advantage of this predation. C. F. Barrett, pest control officer with the Saskatchewan Department of Agriculture has stated (Barrett, 1970) that perhaps the tremendous rise in the number of rodents is due in part to the way we have depleted coyotes and skunks. Then, of course, the fact that a rodent poisoning campaign must eventually be undertaken when this natural control is gone is a new expense and hazard (Nelson, 1970; Perry, 1970; Barrett, 1970). In fact, Cole makes the interesting observation that with the decrease of predatory birds, the mammalian enemies of rodents become increasingly valuable. Regarding insects, the fact that 71 per cent of one young coyote's stomach contents were grasshoppers (Van Wormer, 1964) indicates some benefit to man. A flyer issued by the Monte Nido Horsemen's Association, Calabasca, California, praises predators thus: "Stop — don't kill coyotes or foxes — they are our allies. They kill germ-infested rodents and . . . are nature's own non-poisonous pesticide. For every dollar they cost you, they will repay twenty."

There may be some advantage in the coyote as a counter against the red fox, with which it competes. According to Hugo Maliepaard, DNR (pers. corres.), there has been a tremendous increase in foxes along with the decrease in coyotes in Saskatchewan since the late 1950's. These predators may pose an even greater control problem than the coyote because they are reluctant to take carrion and hence are harder to poison.

The main proponents of coyote control programs are ranchers, intent on protecting livestock. I was unable to obtain figures on livestock damage in Saskatchewan, but apparently the biggest concern lies with sheep, calves and poultry. Although individual ranchers may suffer considerable losses to coyotes, the total economic picture must be considered, and this is complex. As an example, Dobie (1949) points out that "a coyote that means loss on a poultry farm may be a positive gain in an alfalfa field where gophers are working." Perry (1970) attempts an analysis of the situation during 1969 in Arizona: 1864 coyotes killed at a cost of $80.88 per coyote (!) — $157,603. Estimate of stock killed by coyotes — 539 sheep, 375 poultry, 182 cattle, 41 pigs, 17 goats, 3 dogs and cats, 2 horses—value of $42,225. The program, then, represented a net cost of $115,378. In addition, Perry points out that coyote control jack rabbits which compete with stock for forage, especially on depleted or overgrazed range. He suggests that 148 blacktailed jack rabbits consume the forage that could support one cow, or five sheep. Assuming that five coyotes would destroy this number of rabbits in a year, the 1864 coyotes killed in 1969 were equivalent to range forage for 373 cattle — worth about $53,000. In other words, the value of the coyotes in controlling forage-eating rabbits exceeded the loss in livestock.

This benefit to farmers was pointed out back in the early 1950's by the Toponas Grassland Protective Association (Van Wormer, 1964). The organization's claim was that for 10 years they had seen a steady increase in mice, gophers, moles and rabbits to the point where these were taking up to one-third of the hay crop, and cutting



STOP

Don't Kill *COYOTES*

or Foxes - they are our allies

They KILL GERM INFESTED RODENTS AND GERM CARRYING RATS, They are Nature's own non-poisonous pesticide.

Give Nature a chance NOW

For every dollar they cost you they will repay twenty.

M. N. H. Assn.
and
Conservation Now Assn.

(Monte Nido Horsemen's Association, Calabasa, California 91302)

Poster, DWN, Spring 1971

the carrying capacity of the range lands by one-half. The association condemned the use of poison (especially 1080 which it called a deadly chain killer) and stated that on the land of their members, the coyotes were to "live without persecution and to increase in numbers so that they can once again play the role that nature intended, and be an effective check on the rodent population."

The theories of Alfred Etter on coyote ecology, as outlined by Olson (1971, pt. 3) should be examined. Etter suggests that the coyote, if left alone, will choose a territory, exist on small prey, and probably not bother sheep or cattle. One government trapper, for example, tried to kill a pair of coyotes for nine years but only succeeded in getting the pups. When he finally got the parents, "strangers" moved in and a real probem with predation on sheep developed, whereas before there had been none. Etter claims, also, that if human control of coyotes were abandoned, abnormal increases might occur but only until territories were established by the stronger animals. Perry (1970) points out that sheep loss in Arizona, where a strong control program exists, represents 0.10 per cent of sheep and lambs on Arizona ranches, and on the Lava Beds National Monument of California, where no controls are used on the flourishing coyote and bobcat population, the loss to predators was essentially the same at 0.12 per cent. In this case, natural controls seem as effective as poison controls.

The failure of the poison control programs may be in part due to the disruption of territories, causing more coyotes to turn to livestock, but it is also due to the fact that poison is not selective. Numerous authors suggest that the "problem" coyotes are the old, weak, or maimed (Maliepaard, pers. comm.; Ont. Dept. Lands and Forests). Van Wormer (1964) says that a crippled coyote will consume 50 per cent more livestock than a normal one. Poison, of course, kills any that will eat it — and perhaps these older ones are too crafty to eat the poison. This same non-selective problem was seen with the bounty system (Paynter). It would seem that where coyotes are creating a real problem, the ideal solution is live-trapping (Nelson, 1970; Ont. Dept. Lands and Forests). In this way, only coyotes need be taken; the animal remains at the site so it is possible to know when a particular "miscreant", perhaps a cripple, has been captured; the pelt may be usable; and the system is humane.

One further reason for coyote control was put to me by a DNR officer, the fact that coyotes can carry rabies. Although I was not given the numbers of rabid coyotes encountered, I very much doubt if the situation is different from that which prevails in Ontario where "coyotes do not appear to be commonly affected by rabies." Raymond Bock, M.D. (1970) claims that the answer to rabies control lies in the immunization of domesticated animals, since 90 per cent of all reported rabid animal bites are from the dog, and 8 per cent from other domestic animals including cats, horses, and cattle. The 2 per cent remaining are from wild animal pets and wild animals. Bock further points out that rabies often sweeps through an area when a population of animals is in peak numbers. The survivors are immune and keep the area relatively free from rabies for many years. It is not logical for man to try to exert control by killing large numbers of animals, immune and suspectible alike.

Some provinces are recognizing the value of the coyote and the wolf. The Manitoba Department of Mines, Resources and Environmental Management adopted the wolf as its symbol, with the explanation, "we are also undertaking to see that it [the wolf] gets the necessary protection to maintain a reasonably abundant population. It means we understand (or try to understand) the complex interrelationships of nature [and] we recognize the value of all life forms" (Mair, 1970). This approach is reflected also in a publication by the same department entitled, "The wild dogs — a story of wolves in Manitoba." A pamphlet published by the Ontario government advocates management of the coyote, "on the same basis as other game animals — control when and where needed, and freedom from control when it is not required." On the other hand, I understand that Alberta still has an active coyote control program which favors the use of poison.

The DNR is now undertaking a study of the ecology of the coyote in Saskatchewan and until this is complete it will be difficult to assess the need for coyote control in this province. However, it would seem wise for conservation groups and interested individuals *now* to demand that that study answer at least these questions: What is the actual annual livestock loss which can be directly attributed to predation by the coyote? What is the advantage of the coyote in terms of its preying on rabbits, mice, rats, and insects? What is the balancing effect of the coyote on the red fox population?

In addition, because coyote ecology is tied up with the use of 1080 or other forms of control, these questions should be asked: What is the annual loss of other animal species due to the use of 1080? (Unfortunately, this question cannot be satisfactorily answered because the animals in question are not located and cause of death cannot be diagnosed.) What is the total cost of the 1080 poisoning program? What is the possible pollution effect of 1080? Why is a trapping system of coyote control not introduced in those circumstances for which control is proven necessary? Is financial compensation to farmers not the cheapest way, in terms of economics and ecology, to deal with livestock losses due to coyote predation?

At present, the DNR is bowing to pressure from some agricultural groups. I have a letter dated December 15, 1971 from Hon. E. Kramer, then Minister of Natural Resources, assuring me that the Department was "very concerned with the role the coyote plays in the balance of nature." Yet, shortly thereafter, without waiting for the results of his coyote study, he announced that snowmobile hunting of coyotes would be permitted. The fact is that there is no clear policy on coyotes. Reading the Fur Act, Game Act, Rural Municipality Act, and Pest Control Act leaves me (and probably civil servants as well) totally confused. It is time to demand an end to poisoning and the start of protection for the coyote, either as a game animal or a fur bearer — strongly, loudly, and repeatedly. Also, if the government does adopt such a protective policy, it is mandatory that that policy be clearly stated and widely advertised, and that there be stiff penalties for abuse. Only then will the public, when they encounter cases of wanton destruction, be in a position to demand action of law enforcement officials.

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THE WHOOPING CRANE IN SASKATCHEWAN

by **Fred W. Lahrman,** Saskatchewan Museum of Natural History, Regina

Southern Saskatchewan is a regular stop-over place for the Whooping Crane in its spring and fall migrations. In the spring the cranes rest during their last main stop before they continue to their nesting grounds. In the fall these same areas provide the first main stop on their 1800-mile return from Wood Buffalo Park to the wintering grounds in the Aransas Refuge in Texas.

Because Saskatchewan lies in the rather narrow flyway of the cranes and we are therefore in a particularly favored location for observing them during their migration, we became (almost accidentally perhaps) interested in the status of the birds and have since been moved to assume a certain responsibility for the protection of this endangered species. From the time when Fred G. Bard* became curator of the Saskatchewan Museum of Natural History in the 1930s the Museum has played an important role in the Whooping Crane's fight for survival. Mr. Bard became an active member of the International Whooping Crane Conservation Association which was formed to prevent the extinction of America's largest and rarest bird. At the Museum, Mr. Bard, who took both a professional and a personal interest in the project, established the policy of publicizing the plight of the crane; he also sought the co-operation of hunters and others whom he asked to report observations that could be field-checked by his staff. This procedure enabled Museum personnel to be-

Fred Bard publicizing the plight of the Whooping Crane during an interview with CBC announcer Dave Cruickshank

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*Fred Bard was the recipient of an honorary doctor of laws degree from the University of Saskatchewan, Regina, May 15, 1970 (see article on Dr. Bard in Blue Jay 28:146-147, December, 1970).

Museum Photo by F. W. Lahrman

Eleven Whooping Crane, including one juvenile, Glaslyn, October 15, 1969

come familiar with the behaviour and habitat preferences of the Whooping Crane. Certainly, the sight of these majestic birds during their migrations was unforgettable. One realizes how rare a treat it was to see a Whooping Crane when one considers that in 1941, with a mortality rate of 50 per cent, the Aransas migratory flock was reduced to 15 birds — a number that surely indicates that the species was close to extinction. At that time, no one could have hoped to see such a large number of birds as I was fortunate enough to photograph at Glaslyn in the fall of 1969.

As I have said, each spring and fall Mr. Bard prepared informative articles for the local press publicizing the plight of the Whooping Crane and asking everyone to ensure the birds safe passage through Saskatchewan (many articles included illustrations to help people distinguish the Whooping Crane from other large white birds). He also elaborated on the history of the Whooping Crane. For instance in one article (*Blue Jay*, 16: 11-14, 1958) Mr. Bard recalls the two nests found 36 years earlier by Neil Gilmour near Baliol (May 19, 1922), and by Fred Bradsahw at Muddy Lake (May 28, 1922). These were the last nests identified in southern Saskatchewan. Not until 1954 were the nesting grounds in Wood Buffalo Park, N.W.T., discovered. Meanwhile, the small non-migratory flock in Louisiana rapidly declined after a hurricane nearly wiped it out in 1940, and the last bird of that flock perished in 1950. The Aransas National Wildlife Refuge, established in December, 1937, included the wintering grounds of the migratory birds and has been an important factor in the survival of the Whooping Crane but the population for many years remained perilously low. Some years were particularly disastrous. In the years 1950, 1951, 1952 (Fig. 1) losses were 7, 11 and 6 respectively. In 1954, three adults were lost and no young reached Aransas. In December, 1954 there were only 21 birds in the wild flock.

Public interest in conservation of the species, built up by the frequent news releases, and by the enthusiasm and optimism of conservationists like Mr. Bard, now assures the bird of fairly safe passage over its long migration route. Currently, according to the December 1971 count, the Aransas flock numbers 59. There is also a captive flock of 21 (17 at Patuxent, three at Audubon Zoo in

New Orleans and one—Crip—in the San Antonio Zoo in Texas). This captive flock is mainly the result of a new program of removing one egg from each nest in Wood Buffalo National Park and hatching and rearing the young at Patuxent in Maryland. The program began in June 1967 when Ernie Kuyt, Canadian Wildlife Service biologist, collected six eggs.

The present total of 80 Whooping Cranes is encouraging, but we are far from having saved the species from extinction. The education of the public must be continued because the Whoopers are not quite the wild and wary birds they used to be, perhaps because they have faced less gunfire in recent years. I have, for instance, seen them pass low over groups of people, cars and buildings. They can thus be very vulnerable to the irresponsible vandal with a gun; how vulnerable is shown by an incident last spring in which four Whistling Swans were shot and left lying in a field near the Moose Jaw Creek.

And the birds face many hazards. The breeding area is so far north that the nesting season is extremely short and subject to cold and unfavorable conditions. Then, too, one needs only to scan newspapers and magazines to see what is happening to environment and wildlife the world over. Almost any setback that would normally be absorbed by a common species could eliminate the Whooping Crane.

The plan underway at the Patuxent Research Centre to establish a new Whooper flock is a major step in the right direction. It should be borne in mind that the Whooping Crane normally lays only two eggs per clutch and rarely raises more than one young. As only one egg has been taken from any one nest, this has caused no loss to the wild flock (Fig. 1) and it has actually produced a bonus group of young to be added to the annual migrant young. It is imperative to continue this program now while the wild flock is large enough to give six or more eggs to the program each

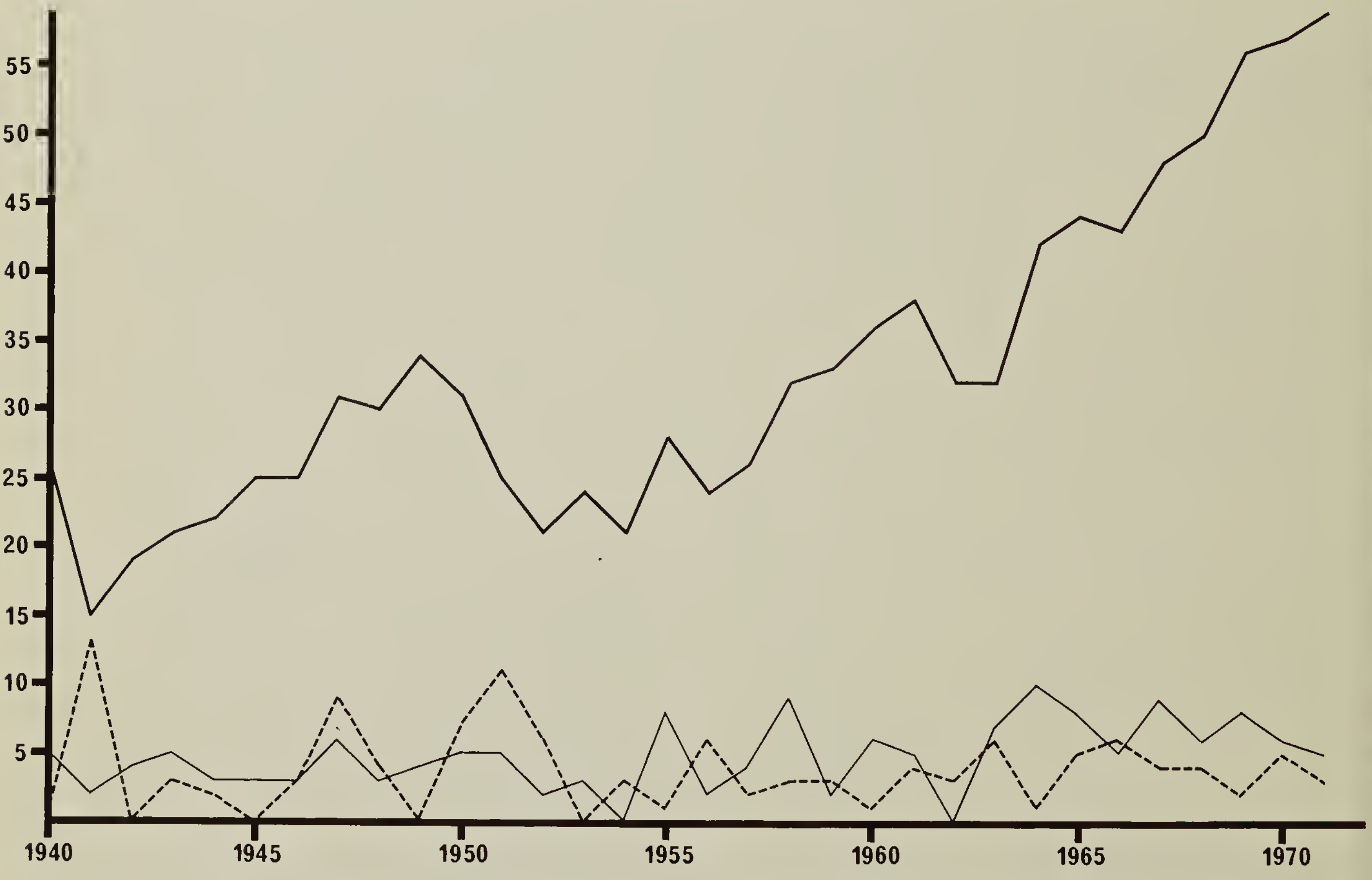
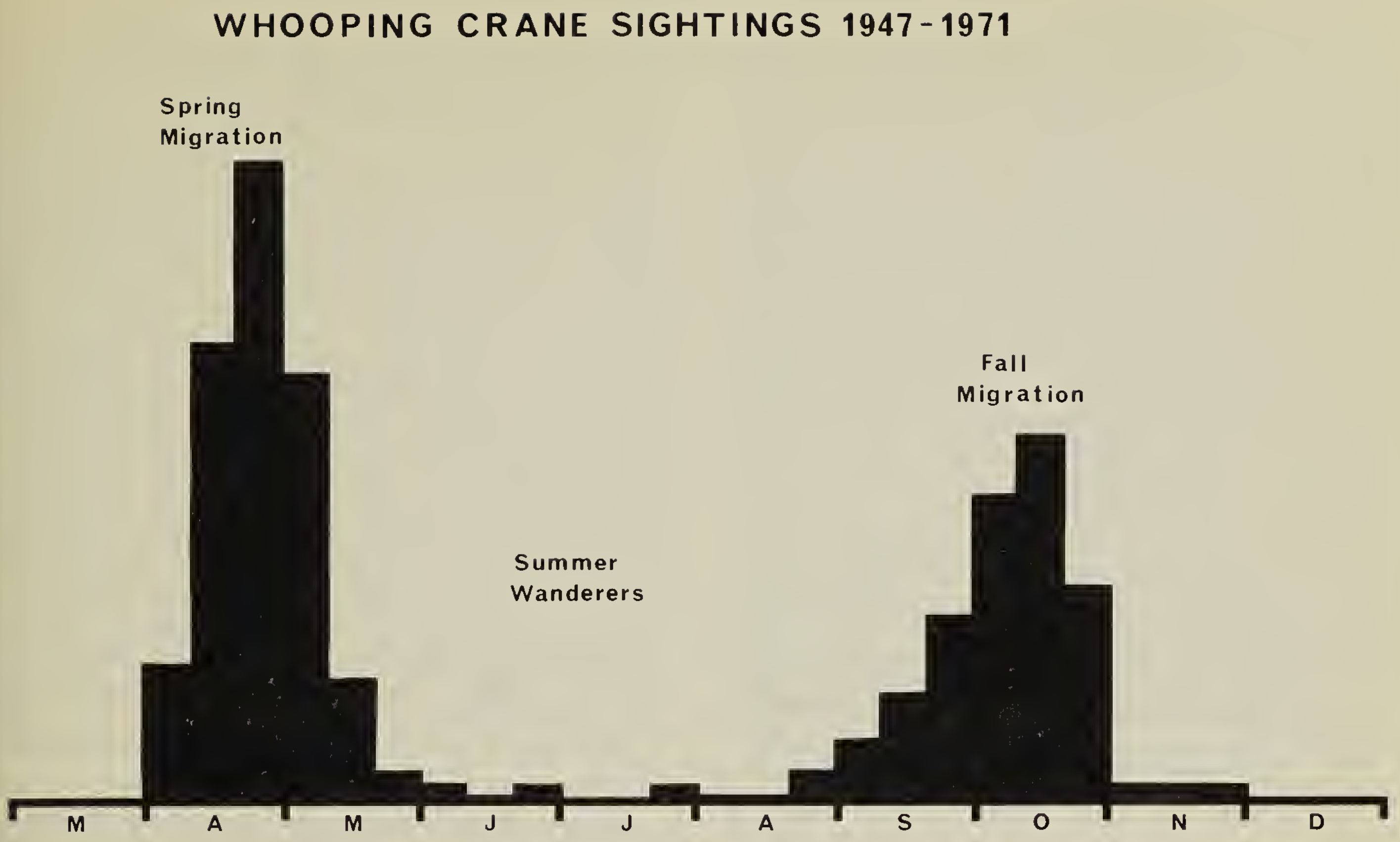
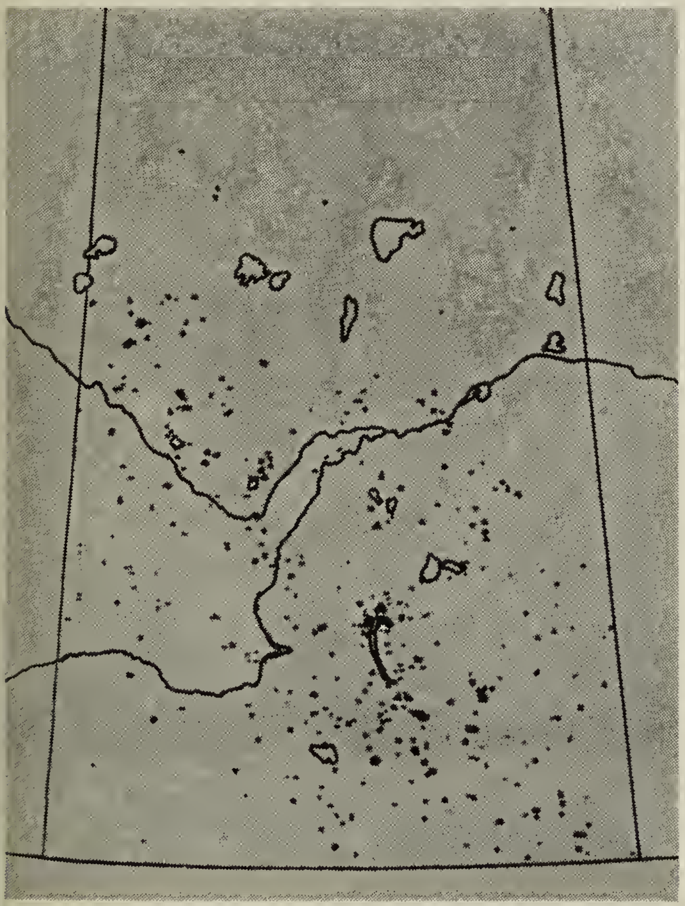


Fig. 1. The upper line denotes the total Aransas Refuge December populations of the Whooping Crane. The lower solid line represents the number of young added to the population each year. The broken line represents the annual loss of adults.



year; if the flock should drop to 15 or 20 again, it would be impossible to continue the program. That Crip and Josephine produced four young in the New Orleans Zoo, and that later Crip and Rosie produced fertile eggs, are ample proofs of the fact that the birds can be managed in captivity. (Unfortunately, both Josephine and Rosie are now dead.)



Location of Whooping Crane sightings in southern Saskatchewan, 1947-1971. There have been a total of 208 pooled observations during these years in the peak period, the last third of April.

Fred Bard and I have several times visited the Aransas Refuge and the New Orleans Audubon Park Zoo. On one of these occasions we had the thrill of seeing and photographing Crip and Josephine at their nest. We also saw Rosie at the San Antonio Zoo where she was being left alone at that time. I am, however, critical of the way that the captive birds are being managed. Three of the four young cranes raised by Crip and Josephine are still in the New Orleans Zoo and they range from 11 to 15 years in age. They have not yet mated and in their present surroundings they probably never will mate. It is obvious that their lives are being wasted; they are far too precious to be kept as mere zoo attractions. Since the captive flock now numbers 21, it must begin to reproduce. We cannot continue to allow eggs to be taken from the wild unless they can be used to insure the survival of the species.

I believe that certain patterns of behaviour in the Whooping Crane's psychology must be complied with to allow every mated pair to become

Photo by F. W. Lahrman

Whooping Crane near Moose Jaw, October, 1965

established. To facilitate the selection of mates I would suggest that unmated birds be released in a large, rigidly protected enclosure (perhaps several hundred acres of suitable marsh land formerly occupied by Whooping Crane would fulfill the requirements). Breeding Whooping Cranes are very territorial and will not tolerate any other crane near their nesting area; therefore, mated pairs must be removed to become established in another suitable location where they will not be disturbed by sight or sound of other Whooping Cranes. This is the considered opinion of Fred Bard who is convinced that Jo and Crip failed to nest because the four young of previous years (now adults) were kept in pens near by.

In attempts to increase the total population, then, every captive Whooping Crane must be used to the best possible advantage. Not only must the birds be given the opportunity to mate but attempts must be made to reduce inbreeding to a minimum. When the birds have selected mates, they must be given suitable territory within which they can reproduce. Since there was once a resident non-migratory flock in Louisiana, and since a number of wildlife refuges in the state could be utilized, I believe that a non-migratory flock might be established there as soon as mated breeding pairs become available among the captive birds. Since the Whooping Crane nested in southern Saskatchewan as recently as 1922, and since the Wood Buffalo Park must be a hazardous nesting area for the Whoopers, I would like to see a marsh in southern Saskatchewan designated as a potential breeding area for a second migratory flock. Many of these recommendations have been made on numerous occasions by Fred Bard on the basis of his personal observations and evaluation of reports.

I would like to pay tribute to all those who have worked so diligently to preserve the Whooping Crane, and to the public whose concern and support have no doubt tipped the balance in favour of the Whooping Crane and enabled it to reach the number we have today. The future holds some promise for the Whooping Crane but I would urge that additional projects be established to provide more opportunities for success and to use each precious year to its fullest potential.

MEETING IN REGINA

The International Whooping Crane Conservation Association is holding its 1972 meeting in Saskatchewan. There will be two days (September 18 and 19) of papers and films and then a field trip to Last Mountain Lake to see Sandhill Crane and, hopefully, Whooping Crane on migration through Saskatchewan. Members of SNHS are invited to register and to attend. Program details may be obtained from the Museum, Wascana Park, Regina.

Join the Association and help save the Whooping Crane.

A 1921 PHOTO OF WHOOPING CRANE

by **Kerwin James Finley,** 408 Ruth St., Saskatoon

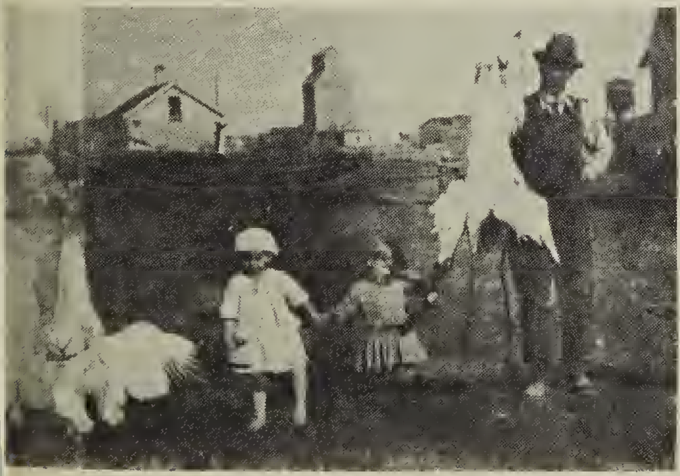
My grandfather, the late J. V. Finley of Luseland, Saskatchewan, once told me a story of killing Whooping Cranes. I had always been of the opinion that the birds in question were probably Whistling Swans until recently when I came upon the accompanying photos while rummaging through some of his old photo albums. I then contacted my grandfather's partner, Mr. Joe Perry, who helped fill in the details.

According to Mr. Perry, the unfortunate event occurred in 1921 at "Buffalo Coulee", 15 miles due south of Luseland. To quote from his letter:

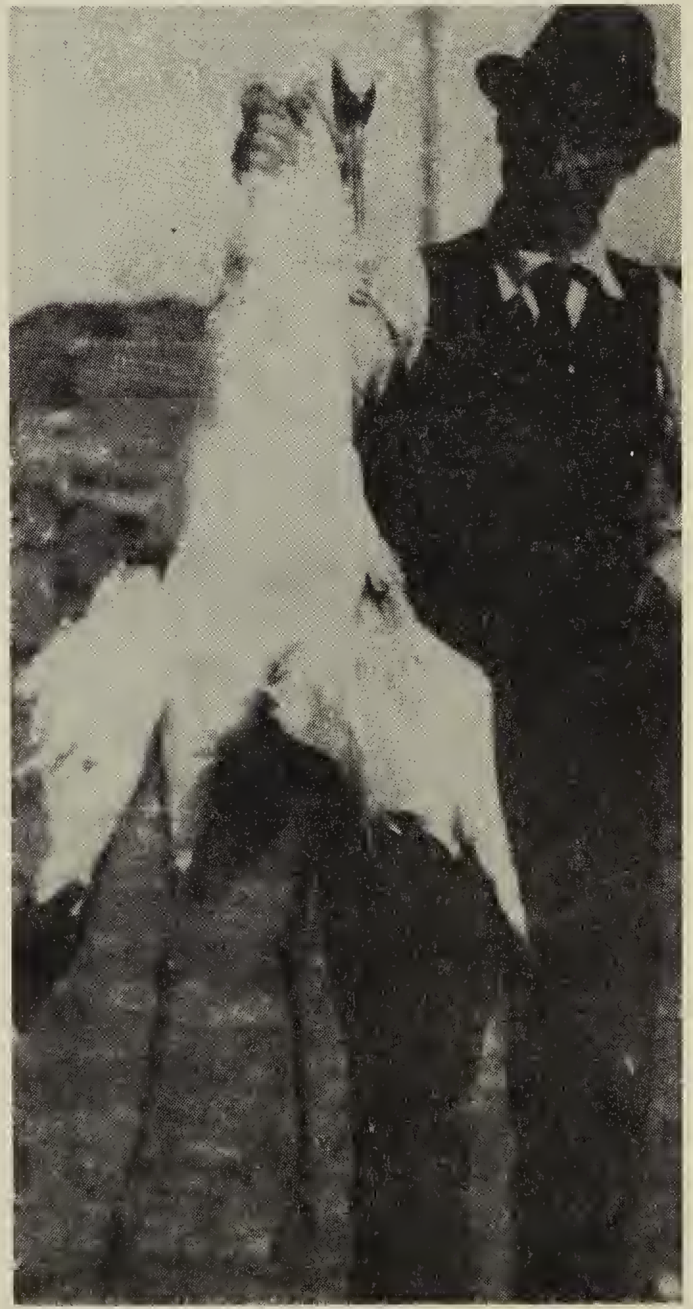
"It was early and quite dark and we were pitted for geese, when up against the horizon loomed three big birds. So we killed two dead and number three went away in the dark also hit — we couldn't find it. We really didn't know they were so scarce — took them with us to Kerrobert and were informed by Hanbidge (Mr. Denny Hanbidge who became Lieutenant-Governor of Saskatchewan, and was a good friend of J. V. Finley), who said the game department might want to hang us for the crime. We gave one away and the people told us they cooked the bird for fours hours, then it was so tough they fed it to the dog."

My grandfather later found out from an irate farmer near Buffalo Coulee that the adults had nested there every year prior to 1921 and had raised a "golden colored young one." Mr. Perry also referred to this in his letter, saying "They had raised one young one which was a golden color the first year, but it never came back the following spring. That balances up with the old Indian legend about the Golden Bird that never returned."

My late grandfather always felt very guilty about the episode — and confided it to me only in his later years. Since it is documented by a photograph, I thought this account would be of interest.



Two Whooping Crane killed in fall, 1921, near Kerrobert



Detail from illustration at left

Ed. note: Buffalo Coulee, near Superb, Saskatchewan, was thus the third last nesting site of the Whooping Crane in Canada. Another nest was found about 10 miles to the northeast in the following year, May 19, 1922, by Neil Gilmour, and another some 30 or 35 miles NNE on May 28 - June 1, 1922, at Muddy Lake, 7 miles south of Unity, with one egg and one young collected. These were the last nests recorded until the discovery by W. A. Fuller, in 1954, of the Wood Buffalo Park nesting grounds.

We should like to suggest that the government prepare a sanctuary in one of the above areas, probably Muddy Lake, where in years to come some of the captive birds now being raised at the Patuxent Wildlife Research Center might be released into the wild in order to restablish themselves in their natural environment.

EARLY WHOOPING CRANE NEST RECORDS NEAR YORKTON, SASKATCHEWAN

by **C. Stuart Houston,** 863 University Drive, Saskatoon

Whooping Crane observations from 1890 to 1942 were given in my report on the birds of the Yorkton district, Saskatchewan (*Can. Field-Nat.*, 63: 215-241, 1949), though nesting information was not cited.

R. P. Allen's comprehensive monograph on the Whooping Crane (Research Rep. No. 3, Natl. Audubon Soc., New York, 1952) listed seven Saskatchewan nest records: Moose Mountain, 1881; Battleford, 1884; Yorkton, 1900; north of Davidson, 1911; Bradwell, 1912; Baliol, 1922; and Muddy Lake near Unity, 1922.

The Yorkton record was substantiated by two eggs in the Thayer Collection, now in the Museum of Comparative Zoology at Harvard University, Cambridge, Massachusetts. I wrote to James C. Greenway, Jr., Curator of Birds, and his reply of April 7, 1954 stated that the label read as follows:

> "From the Oological Coll. Walter Raine, Toronto, Canada, Yorkton, No. Assiniboia, 16 May 1900. 2 eggs (Fresh). Collector: Cowboy Brown.
>
> "Nest: a mass of marsh hay on the prairie 3 feet in diameter, birds very wary, collector Cowboy Brown."

Greenway stated that these eggs could not be differentiated with certainty from eggs of the Sandhill Crane. Enquiries to museums in eastern Canada and old-timers in the Yorkton area were made but the identity of "Cowboy Brown" was not established.

Further information concerning the probable nesting of Whooping Cranes in the Yorkton area was obtained from the Fernie brothers, both of whom farmed near Springside. About 1955, William Fernie told Cliff Shaw how he had settled first in the Wallace district northeast of Yorkton in 1883 and then moved to Springside in 1889. The last Whooping Crane Fernie had seen was a single young bird at Horseshoe Lake, "the year that Donald Gunn was flooded out." Several years prior to this, no doubt in the 1890's, Fernie had seen a Whooping Crane nest with two white eggs on top of a muskrat house on "Battersby's Lake" later known as "Scheller's Slough", between the old J. Carson ranch and Horseshoe Lake, on section 25, township 28, range 5, six miles west of Gorlitz.

In addition, William Fernie told Cliff Shaw that in the spring the "whoop" call of the Whooping Crane could "be heard for five miles on a quiet morning." He saw no more than three birds together at any time, whereas Sandhill Cranes were much commoner and the Indians often made a meal of "a pot of potatoes and a young sandhill."

In late 1958, when Cliff Shaw gave me the notes of his interview with

William Fernie, I tried to contact Mr. Fernie, only to learn that he had died in December, 1956. However, his brother, Peter E. Fernie, wrote to me on December 2, 1958 and I visited him on September 25, 1959, when he was 77 years of age. Peter Fernie settled first in the Rhein district northeast of Yorkton in 1885 and then moved to the Springside district in 1894. He told me that he had seen only four Whooping Cranes in his lifetime. They were very shy birds, but one year near 1900 a pair resided all summer in the "Fernie meadow", where a ridge runs out into a big marsh, adjacent to Cussed Creek, four miles west and one mile south of the present village of Springside. He saw the cranes dance and heard them "whoop", and they laid a single, large, dirty white egg on a muskrat house. He said that Sandhill Cranes were scattered throughout the countryside then, and that he had once found two Sandhill Crane nests in the same meadow. This locality is southwest of Springside, whereas that described by William Fernie was northeast of Springside.

Unfortunately, our most reliable source of information for the Horseshoe Lake area, the late John A. Gunn, was too young to be out searching for crane nests in 1890. Born in August, 1883 near Fort Qu'Appelle, he was the son of the Donald Gunn mentioned above, and the grandson of the famous Donald Gunn who kept meteorological observations and who collected natural history specimens for the Smithsonian Institute, at the Red River settlement in Manitoba in the 1850's and 1860's.

The Gunns cut hay along the west side of Horseshoe Lake and John, though not quite seven years old, remembered seeing Whooping Cranes there about the spring of 1890. Sandhill Cranes remained common each summer until about 1896, and he too, found a nest of this species, but Whooping Cranes were not sighted again by the Gunns. Donald Gunn, Jr., left about 1902 and John died August 12, 1947, but John's wife and daughter Joyce (now Mrs. William Anaka), are still active members of our society and continue to live at their home which is located within a recent extension of Good Spirit Provincial Park.

SIGHTING OF BAND-TAILED PIGEON IN SOUTH-CENTRAL ALBERTA

by **A. E. Barnard,** 934 Odlin Rd., Richmond, B.C.

On July 10, 1971 the writer and Mr. Kim Hodson were conducting raptor research for the Canadian Wildlife Service in the Hanna area of south-central Alberta. While driving north on Hwy. 36, approximately 1½ miles north of the Sheerness turn-off, we observed a large pigeon-like bird flush from the shoulder of the highway and fly to a fence-post, on which it landed. Using 7 x 35 binoculars, the following physical characteristics of the bird were noted:

a) general morphology of the domestic Pigeon *(Columba livia)*.
b) bright yellow bill with a black tip.
c) bright yellow feet and legs.
d) metallic-greenish nape bordered posteriorly by a white semi-collar.
e) rosy-hued breast and sides.
f) grey back and tail.
g) squarish tail.

All of these are described (Peterson, 1961; Godfrey, 1966) as diagnostic characters of the Band-tailed Pigeon *(Columba fasciata)*. The development of the plumage indicated that it was an adult of this species (G. L. March, personal communication).

Although I was unable to collect or photograph this specimen, there is no doubt on the part of Mr. Hodson or myself as to the validity of this sighting. Both of us normally reside in the Band-tail's recognized range, Mr. Hodson on southern Vancouver Island, and I on the outskirts of Vancouver. Consequently, both of us have the opportunity to observe this handsome bird frequently. In addition, I have hunted this bird almost annually for the last 15 years, and therefore have had many opportunities to observe morphological characteristics close at hand.

The area in which this bird was sighted is largely short-grass prairie, sparsely interspersed with small bluffs of poplars *(Populus* spp.*)*. According to March (1971), the Band-tailed Pigeon is locally common in southwestern British Columbia and is confined to that area west of the Cascade Mountains.

This is apparently the third sighting of a Band-tailed Pigeon in Alberta during recent years. A specimen was obtained on July 27, 1967, at Leduc, Alberta, by Mr. Harvey Burns (Spalding and Hampson, 1969). A second sighting was recorded from the foothills country west of Calgary on August 16, 1968 (Wilson, 1968). The status of this species in Alberta is as yet undetermined.

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VARIATION IN DENSITY OF BREEDING DUCKS ACROSS THE ASPEN PARKLANDS AND GRASSLANDS OF CANADA

by **Kees Vermeer,** Canadian Wildlife Service, Edmonton, Alberta

The aspen parklands and grasslands of the Prairie Provinces of Canada contain potholes, marshes and lakes and constitute the major breeding ground for most game duck species in North America. Excluding scoters, eiders, mergansers and oldsquaws, Crissey (1969) estimated that during 1955-64 an average of 47 percent of the North American duck population and 61 percent of the Canadian duck population utilized this region for breeding.

This region has been divided into 10 survey strata (Fig. 1). Table 1 shows the biotic zone and area of each stratum. Stratum 25 is an exception to the other nine strata in that it is in the boreal forest. However, much of the boreal forest has been cleared in this stratum, making it similar for waterfowl observing to those encountered in adjacent parkland. For this reason it has been included here.

In May, surveys are carried out within each stratum to determine the status of waterfowl breeding populations. Average numbers of breeding pairs per square mile during 1960-69 for the 10 survey strata are given for Mallard *(Anas platyrhynchos)*, Pintail *(Anas acuta)*, Gadwall *(Anas strepera)*, American Widgeon *(Mareca americana)*, Shoveler, *(Spatula clypeata)*, Blue-winged Teal *(Anas discors)*, Green-winged Teal *(Anas carolinensis)*, Redhead *(Aythya americana)*, Canvasback *(Aythya valisineria)*, and Lesser Scaup *(Aythya affinis)*.

The purpose of this study was to determine for each species the breeding pair density in each stratum and the preference for a biotic zone.

Methods

The annual breeding pair surveys have been conducted and published by the U.S. Bureau of Sport Fisheries and Wildlife. Detailed description of the methods used in the waterfowl breeding pair survey is given in the United States Fish and Wildlife Service manual: *Standard Procedures for*

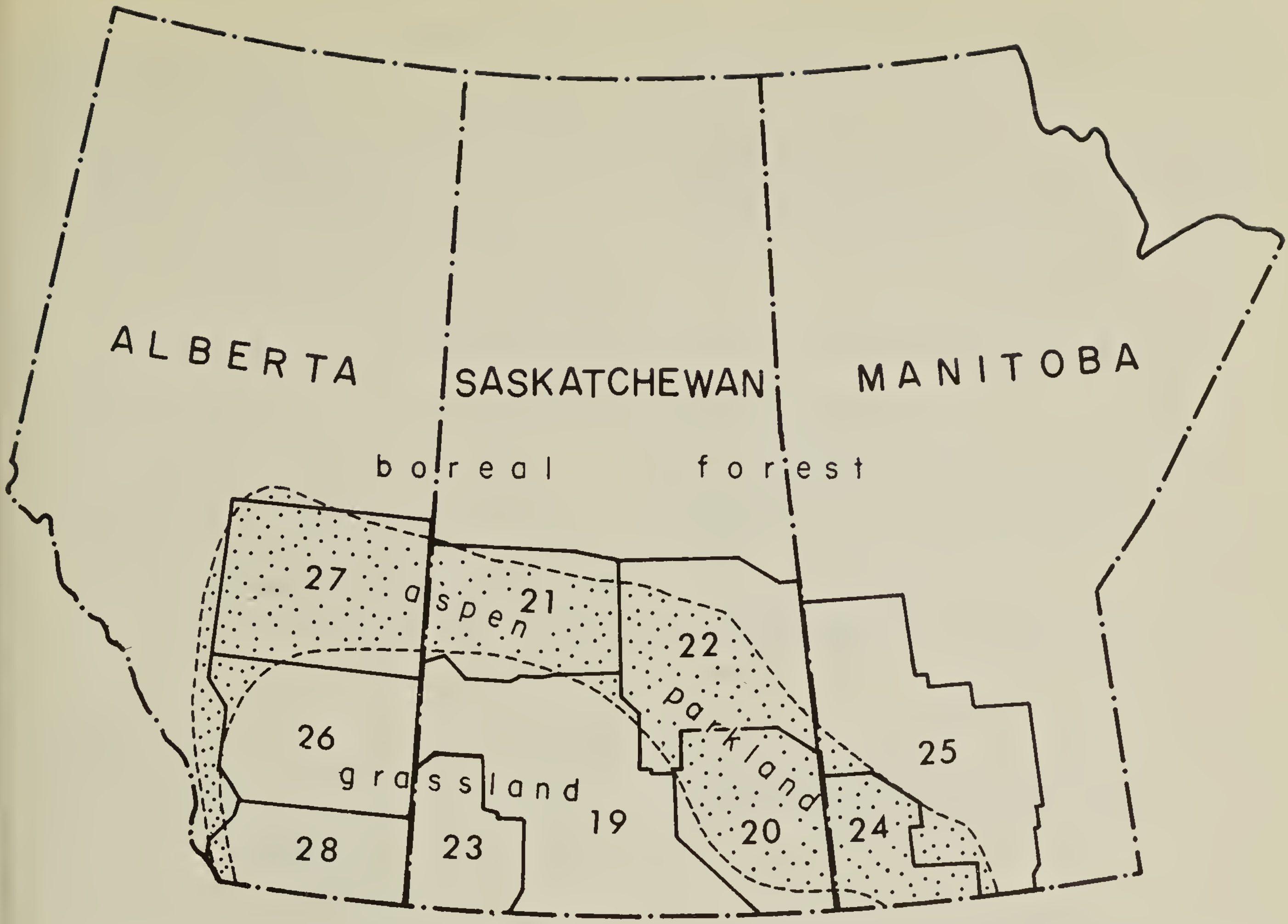

Fig. 1. Geographic locations of waterfowl survey strata in the aspen parkland and grassland.

Waterfowl Population and Habitat Surveys (1969). The waterfowl breeding population indices were taken from the United States Fish and Wildlife Service *Waterfowl Status Reports* (1960-69).

$$\text{Population index} = \text{Aerial count of breeding ducks} \times \frac{\text{Stratum area}}{\text{Surveyed area}}$$

$$\text{Visibility rate} = \frac{\text{Aerial count}}{\text{ground count}}$$

of air: ground comparison transect

Visibility rates are used to adjust breeding population indices as there are discrepancies between aerial and ground counts. Air:ground comparison transect survey techniques were not perfected until 1961. As no visibility rates were available for 1960, averages of 1961-1969 rates were used for that year.

To obtain figures on average breeding pairs per square mile for the period 1960-69: 1) breeding population indices were divided by visibility rates to obtain adjusted breeding populations for each species by stratum and year; 2) the adjusted breeding populations were divided by the area

Table 1. Biotic zone and area of Survey Strata

Biotic zone	Stratum number	Area (square miles)
Boreal forest	25	28,600 (1960-69)
Boreal forest/ parkland	22	33,720 (1960-66) 38,890 (1967-69)
Aspen parkland	24	10,370 (1960-69)
Aspen parkland	20	14,600 (1960-69)
Aspen parkland	21	16,800 (1960-66) 17,880 (1967-69)
Aspen parkland	27	26,100 (1960-66) 26,090 (1967-69)
Grassland	19	37,630 (1960-69)
Grassland	23	11,290 (1960-69)
Grassland	26	22,090 (1960-66) 24,610 (1967-69)
Grassland	28	16,110 (1960-66) 13,240 (1967-69)
Strata combined		217,310 (1960-66) 218,200 (1967-69)

Table 2. Average numbers of breeding pairs per square mile in the ten survey strata — 1960-1969

	Boreal forest	B. for./ parkland	Aspen parkland				Grassland				Wtd. mean, All strata
DUCKS	25	22	24	20	21	27	19	23	26	28	
Mallard	3.2	9.2	7.5	9.7	10.4	15.8	6.8	5.5	7.7	6.4	8.3
Pintail	1.0	4.0	2.9	4.0	4.9	5.8	6.4	6.0	9.3	8.4	5.2
Gadwall	0.5	0.8	2.2	1.3	1.7	4.2	2.8	2.0	2.6	1.2	2.0
American Widgeon	0.5	2.7	1.9	1.7	4.3	4.8	3.0	2.6	3.1	1.9	2.7
Shoveler	0.9	1.8	2.6	1.6	2.5	3.8	2.7	1.9	3.5	2.0	2.4
Blue-winged Teal	2.8	3.5	12.6	11.2	4.3	8.5	3.6	2.3	3.8	1.5	4.9
Green-winged Teal	0.8	1.1	1.9	0.9	1.9	2.8	1.7	1.3	0.8	0.3	1.4
Redhead	0.7	1.7	1.4	0.2	2.9	1.6	0.3	0.1	1.3	0.8	1.1
Canvasback	0.5	0.5	1.6	0.5	1.7	1.3	0.4	0.3	0.3	0.1	0.7
Lesser Scaup	0.9	1.2	3.1	0.8	2.2	4.6	0.9	0.5	1.7	1.5	1.7
Species combined	11.8	26.5	37.7	31.9	36.8	53.2	28.6	22.5	34.1	24.1	30.4

of each stratum to obtain numbers of breeders per square mile; 3) the resulting figures were divided by two to obtain breeding pairs per square mile; 4) the breeding pairs per square mile were averaged for the 10-year period.

Breeding pair densities of ducks unadjusted for visibility rates in the aspen parklands and grasslands were compared with those of the boreal forest north of that region.

Results and Discussion

Average breeding pair densities during 1960-69 for 10 species of ducks are shown (Table 2) for each of the 10 strata. The densities for seven dabbling duck species are illustrated in Fig. 2 and for three diving duck species in Fig. 3.

Mallards, with the highest density over the entire region, averaged eight breeding pairs per square mile (Table 2). Pintails and Blue-winged Teal had the second highest density. For the 10 species the average density was about 30 breeding pairs per square mile.

Stratum 27, in the parklands of Alberta, had the highest density for the Mallard, Gadwall, American Widgeon, Shoveler, Green-winged Teal, and Lesser Scaup. Pintail densities were highest in Strata 26 and 28 in the Alberta grasslands. Blue-winged Teal densities were highest in Strata 20 and

Table 3. Comparison of breeding pair densities, unadjusted for visibility rates, between the parkland - grassland region and the boreal forest to its north for the period 1961-1970.

Species	Aspen parklands and grasslands	Boreal forest
Mallard	3.8	0.6
Pintail	1.9	0.1
Gadwall	0.6	0.0
American Widgeon	0.7	0.2
Blue-winged Teal	0.6	0.1
Green-winged Teal	0.2	0.1
Shoveler	0.9	0.1
Redhead	0.2	0.0
Canvasback	0.4	0.1
Lesser Scaup	0.9	1.4

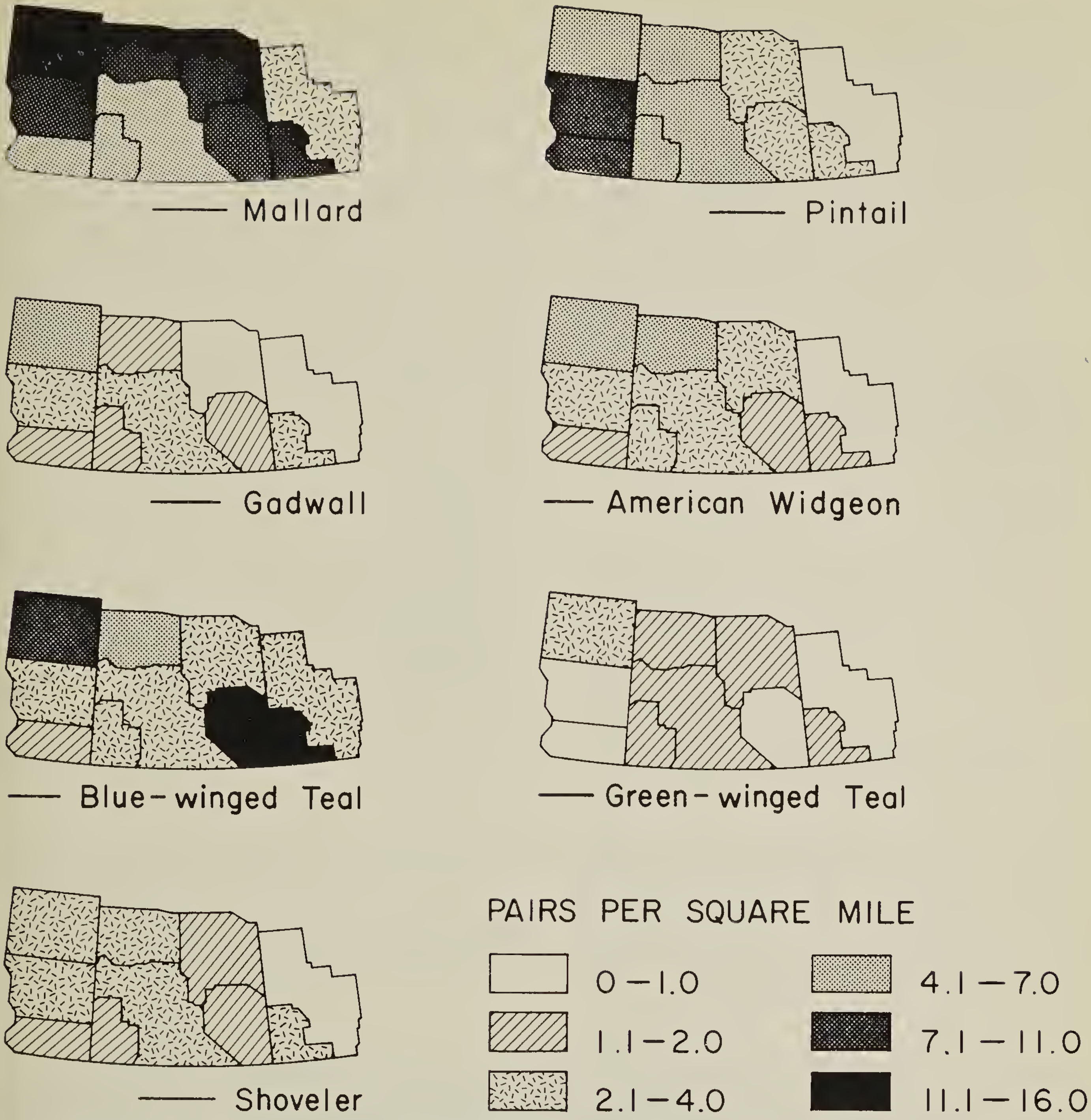

Fig 2. Breeding pair densities of seven species of dabbling ducks in the aspen parkland and grassland.

24, which may be related to the fact that those strata had the highest average number of ponds in May of 1960-1969 of all strata. There was a highly significant correlation between Blue-winged Teal and May pond densities (r = 0.818). No positive significant correlation was found for the other species. The obtained breeding pair density for a species within a stratum probably depends on the interaction of many factors within that stratum, one of which is May pond density. May pond density may be the most important factor influencing Blue-winged Teal densities but not those of other ducks. Densities of Mallard, Redhead, Canvasback and Lesser Scaup in different strata in relation to the vegetation of strata suggests some preference for aspen parkland.

Unadjusted breeding pair densities for the 10 survey strata in the aspen parklands and grasslands are compared in Table 3 with those of survey strata in the boreal forest of northern Alberta, northern Saskatchewan, northern Manitoba, northeastern British Columbia and the Northwest Territories. As visibility correction factors for areas north of the aspen parklands and grasslands are based upon small samples and are of questionable accuracy, the densities can

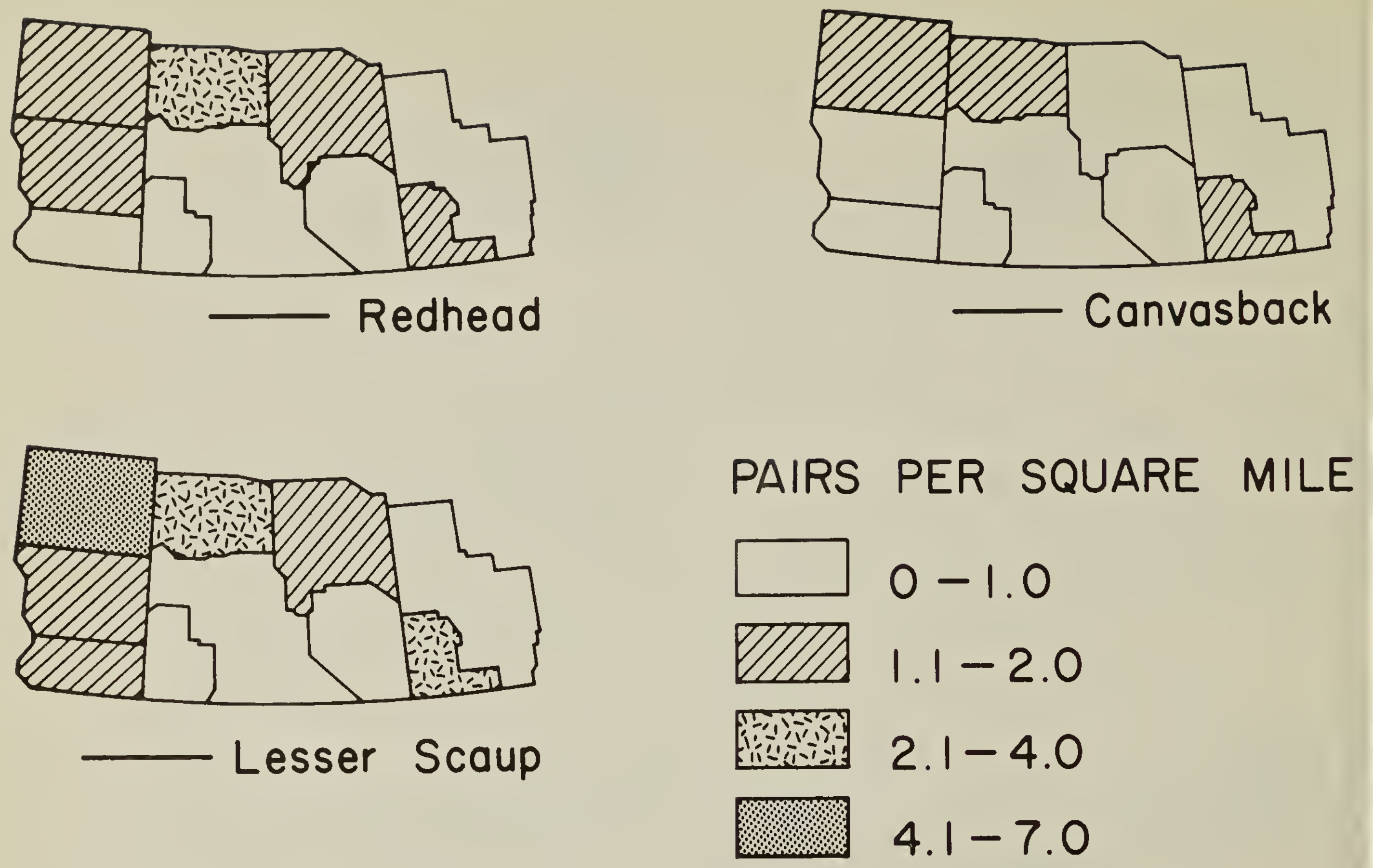

Fig. 3. Breeding pair densities of three species of diving ducks in the aspen parkland and grassland.

only be used on a comparative basis for the parkland-grassland region and the boreal forest to its north. It can be seen that only the Lesser Scaup has a higher density in the boreal forest. That Lesser Scaup are the most numerous breeding duck in the boreal forest is also supported by observations in Alberta by Vermeer (1970), in Saskatchewan by Townsend (1966) and in the Northwest Territories by Murdy *et al.* (1970). A small fraction of the Lesser Scaup density in the boreal forest is probably constituted by Greater Scaup *(Aythya marila).* Murdy *et al.* (1970) found that Greater Scaup in the Yellowknife area appeared to be chiefly confined to islands in Great Slave Lake. Vermeer *et al.* (in press) also found that Greater Scaup was the most common breeder on an island in northern Lake Winnipeg, which is 300 miles south of the breeding boundary for this species as indicated by Godfrey (1966).

Acknowledgments

The author expresses appreciation to his wife Rebecca for reviewing the manuscript; to R. J. Isbister, for his assistance in preparing figures and tables; and to R. C. Hanson and M. Smith for providing visibility rates for survey strata in Saskatchewan and Manitoba for 1967.

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WILDLIFE AND FENCES

by **Hugh C. Smith,** Provincial Museum and Archives of Alberta, Edmonton

Recently Cornwell and Hochbaum (1971) outlined the effect that fences, and telephone and power lines had on the mortality of waterfowl. However, waterfowl are not the only animals affected. The following examples are of mammals and birds killed by wires.

In 1969, while on a field trip for the Provincial Museum and Archives of Alberta, I came across the carcass of a pronghorn *(Antilocapra americana)* that was entangled in a fence. The fence, located on the property of the Manyberries Dominion Range Experimental Station approximately 30 miles southeast of Manyberries, Alberta, was of woven wire construction with two or three strands of barbed wire on top. Apparently the pronghorn, a doe, had attempted to jump the fence. One of her hind legs failed to clear the top strand of barbed wire and she was tripped. In thrashing about trying to free herself she entangled her other hind leg. When found, she had been dead for several days. Although pronghorns have the ability to jump, it is a skill that must be learned (Van Wormer, 1969), and they usually cross fences by crawling beneath or through them. Because the fence was flush to the ground there was no way for a pronghorn to crawl under it, and possibly the lack of experience in jumping caused this pronghorn to misjudge the height of the fence.

Another incident of an encounter with a wire fence is illustrated in Fig. 1. The two mule deer *(Odocoileus hemionus)* were found dead on the farm of Mr. Edward Wesslen of Blackfalds, Alberta, on November 5, 1971. The antlers, which appear to be locked, are held together with strands of barbed wire. It appears that the deer approached each other from opposite sides of the fence and in the ensuing fight became tangled in the fence. In trying to free themselves they tore out 100 feet of fencing and several fence posts. This type of accident is no doubt rare; however, Shaw (1955) reports

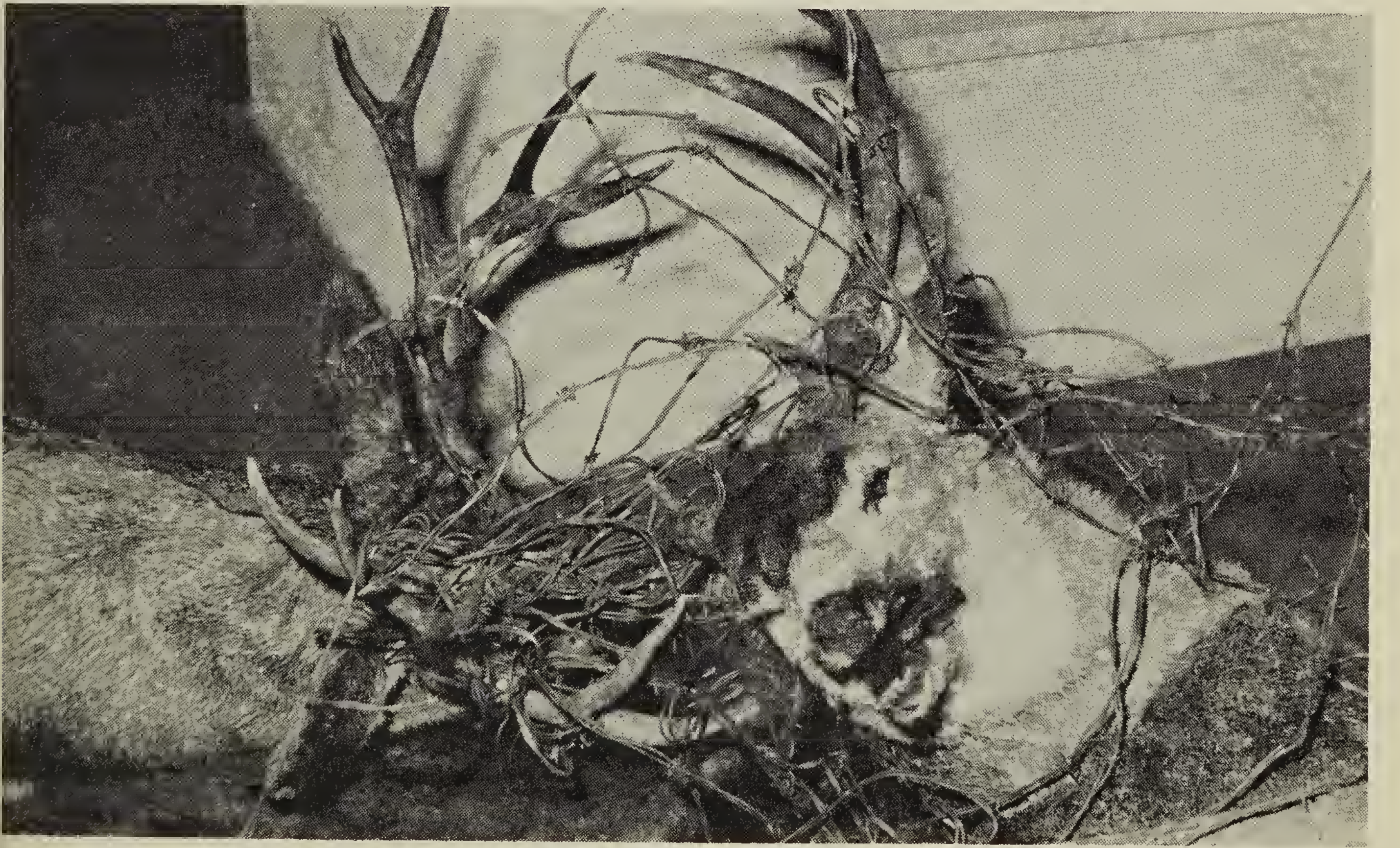

Fig. 1. Mule deer, Blackfalds, Alberta, November, 1971.

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[1] Natural History Contribution Number 11 of the Provincial Museum and Archives of Alberta.

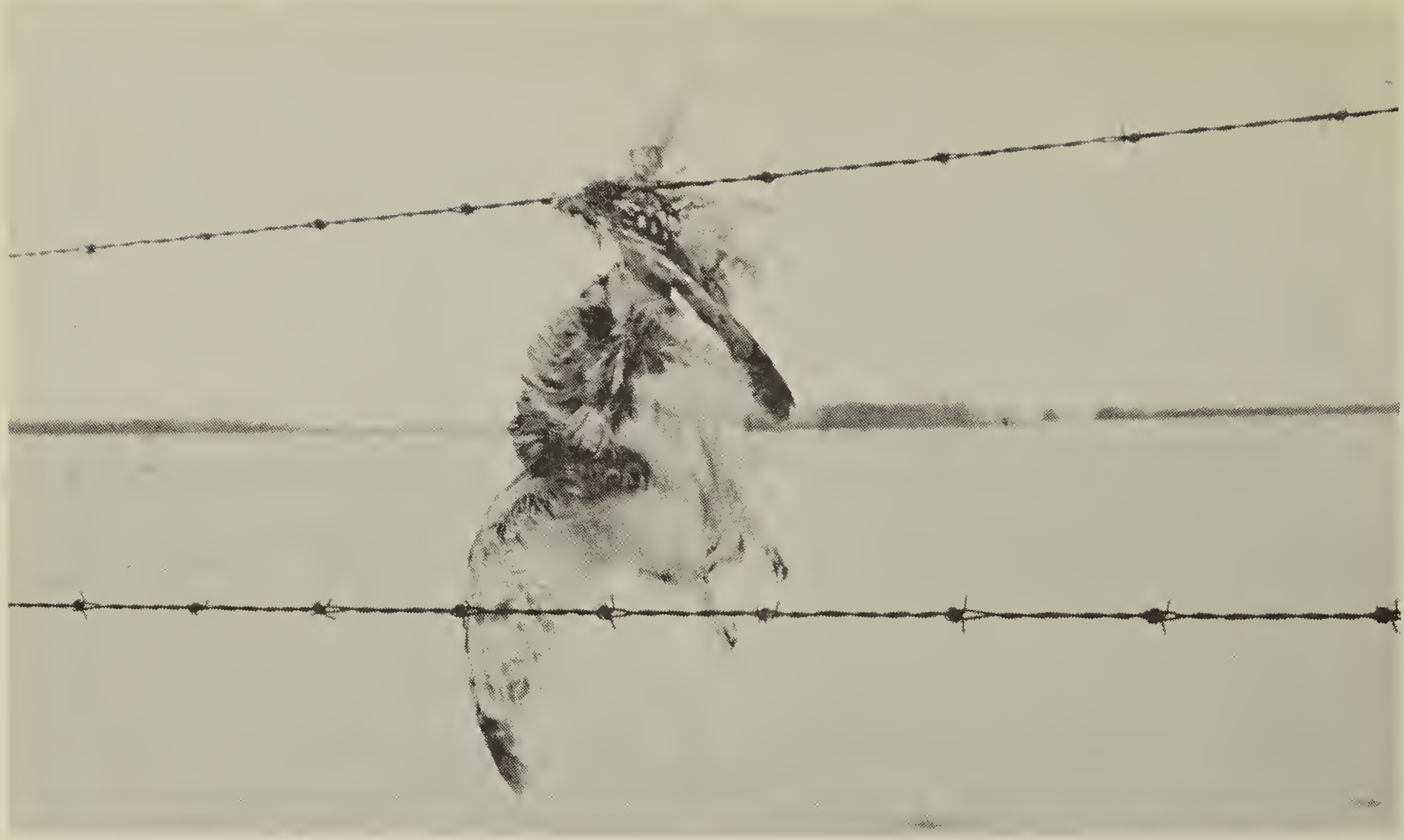

Fig. 2. Short-eared owl, Lacombe, Alberta, February, 1970.

an almost identical situation involving White-tailed Deer *(Odocoileus virginianus)*.

Fig. 2 shows a Short-eared Owl *(Asio flammeus)* caught on a barbed wire fence. At first it appeared as if someone had shot the bird and had hung it on the fence. It had, however, apparently struck the fence while flying, and one wing had become impaled on a barb. The carcass was dry and brittle when found, and the wing broke off when the bird was removed from the wire.

Another example of a bird striking a wire involved a Willet *(Catoptrophorus semipalmatus)*. During the summer of 1971, while travelling south of Cypress Lake, Saskatchewan, I saw the Willet entangled in a barbed wire fence. On examination I found that it was a young bird which had caught its wing on a barb. The wing was not broken, but there was a long tear in the skin, and a considerable amount of blood had been lost. I was able to remove the bird from the wire, and, as it was still alive, I released it at a nearby slough. Its weakened condition, however, would reduce its chance of survival.

In all these cases barbed wire was involved in some way. Unfortunately, the solution offered by Cornwell and Hochbaum (1971), of removing unused fences and wires from the vicinity of marshes, does not apply here. In most of these situations the fences were boundary fences used to separate fields from the public right-of-way. What the solution is in this context is unclear, for it seems that whenever man wishes to delimit his property he uses a fence of some nature. In Alberta and Saskatchewan barbed wire is the most economical and widely used fencing material. Hence, the elimination of this material for fence construction is not a practical solution to the problem.

It may eventually be a case of wildlife's adjusting to man-made structures. Those that are able to live in the vicinity of such structures and survive are possibly the individuals best suited to carry on the species.

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THE BUTTERFLIES OF MANITOBA'S PROVINCIAL PARKS II:

GRAND BEACH PROVINCIAL PARK AND BELAIR FOREST PRESERVE

by **John H. Masters,** P.O. Box 7511, St. Paul, Minnesota

This is the second in a series of articles treating the butterfly faunas of Manitoba's nine provincial parks. Grand Beach Provincial Park, located on Lake Winnipeg 57 miles northeast of Winnipeg, is one of Manitoba's smaller parks. The park is surrounded by the Belair Forest Reserve, which is eminently more suitable than the park for nature studies. The Belair Forest comprises the northern segment of La Petite Montagne de Cypres which extends from Victoria Beach on Lake Winnipeg through the Belair, Agassiz and Sandilands Forest Reserves into Roseau County, Minnesota. This ridge, which was formed as a beach on glacial Lake Agassiz 12,000 years ago, is characterized by shallow sandy soil and mixed deciduous-coniferous forests. Although the forests have been cut over in this century, they are relatively undisturbed now and virtually none of the area has ever been under the plow. The ridge is an excellent area for natural history studies.

Victoria Beach, which is immediately beyond the northern limit of the Belair Forest, is the only part of this area that has received much attention by Lepidopterists in the past. Harold J. Brodie mimeographed a list of butterflies that he had taken at Victoria Beach in 1926; this was published in 1969. George Shirley Brooks, who published the most recent list of Manitoba butterflies (1942), had a summer cottage at Victoria Beach and did quite a bit of his collecting there.

I am including, in this treatment, only those species that have actually been recorded at Grand Beach, Victoria Beach or the Belair Forest. I have, however, spent considerably more time at Sandilands which is farther south on the "Petite Montagne", and most of my observations regarding flight periods and habitats are drawn from this experience.

Swallowtail Butterflies: PAPILIONIDAE

BLACK SWALLOWTAIL *Papilio polixenes asterius* Stoll Recorded from Victoria Beach by Brodie. A species of gardens and open fields that is not very abundant in Manitoba.

TIGER SWALLOWTAIL *Papilio glaucus canadensis* Rothschild & Jordan This species is very conspicuous and common from mid-June to mid-July. The large yellow and black butterflies are seemingly everywhere, on flowers, flying up and down roads or forest lanes, or congregating in large numbers at wet spots on a road or beach.

Whites and Sulphurs: PIERIDAE

NORTHERN WHITE *Pieris napi oleracea* Harris A woodland species that is usually fairly abundant. There are two annual broods, the first one making its appearance in May, the second one in late July.

CABBAGE BUTTERFLY *Pieris rapae* (Linnaeus) Common, especially around human habitation where the larva are pests on garden vegetables. Can be taken from May through September.

CHECKERED WHITE *Pieris protodice protodice* Boisduval & LeConte A roadside butterfly. Only the first brood (in late May) has been observed here, but a second brood is to be expected in mid-summer.

ORANGE SULPHUR *Colias eurytheme eurytheme* Boisduval Common along roadsides, in pastures and in alfalfa fields from mid-summer well into the fall months. Multiple-brooded, but with a continual flight period.

COMMON SULPHUR *Colias philodice philodice* Godart This species is closely related to *C. eurytheme* and found in similar situations.

BLUEBERRY SULPHUR *Colias interior interior* Scudder Both Brooks and Brodie recorded this species at Victoria Beach. I have not seen it here, although it is fairly common in the Sandilands Forest Reserve. Look for it in areas where blueberries grow from early July to mid-August.

LARGE MARBLE *Euchloe ausonides* Lucas ssp. This species is fairly abundant all along La Petite Montagne de Cypres in the first half of June. It seems to prefer jack pine areas, but also occurs in deciduous forests and open fields. Ontario lepidopterists have speculated (because there is a lack of old records) that the species has migrated into this area in recent years—this area being southeast Manitoba, northwest Ontario and extreme northern Minnesota. Brooks (1942) recorded it only from Victoria Beach in southeast Manitoba, but I have found it common at Whiteshell and all the way to Cook County, Minnesota. It is my opinion that the butterfly has always inhabited this area. For one thing, the nearest population from which the butterflies could have come if they migrated here is from along the Manitoba Escarpment (Riding Mountain, etc.) of western Manitoba. This population, known as *E. a. mayi* Chermock & Chermock, is marked in a strikingly different manner from the eastern Manitoba-Ontario-Minnesota population with the females having almost lemon yellow basal areas on their hindwing. Belair specimens are marked quite similarly to *Euchloe ausonides coloradensis* (H. Edwards) from Colorado; I believe, however, that it would be a mistake to apply the name of this distant population to Manitoba individuals until more is known about the relationship between the two populations.

Monarchs:
DANAIDAE

MONARCH *Danaus plexippus plexippus* (Linnaeus) This familiar butterfly is well known to everybody. It does not overwinter in Manitoba and must migrate in from the south. It succeeds in doing this almost annually in the prairie regions but less frequently in forested areas.

Satyrs and Wood Nymphs:
SATYRIDAE

EYED BROWN *Lethe eurydice eurydice* (Johansson) Recorded from Victoria Beach by Brooks and Brodie. I have not taken it in this area. It should be sought in sedge meadows during July and August.

NORTHERN PEARLY EYE *Lethe anthedon borealis* (Clark) Occurs in more boreal coniferous forest areas from June to late July.

LITTLE WOOD SATYR *Euptychia cymela cymela* (Cramer) Recorded from Victoria Beach by Brooks. This is a species of deciduous woodlands; I have taken it in the Sandilands Forest Reserve in June.

GRAYLING *Cercyonis pegala nephele* (Kirby) A common roadside butterfly in late July into August; also at home in pastures and deciduous woods.

RINGLET *Coenonympha tullia inornata* Edwards Very common throughout southern Manitoba in pastures, vacant fields, hay fields and native prairies. From mid-June until mid-July.

Erebia discoidalis discoidalis Kirby Recorded from Victoria Beach by Brooks. In southeast Manitoba, this species prefers sedgy bogs as a habitat. It should be sought in late May or early June.

MACOUN'S ARCTIC *Oeneis macounii* (Edwards) G. S. Brooks collected many hundreds of this species at Victoria Beach, the only place that he knew of in Manitoba where it occurred, and sent these to his correspondents throughout the world. He was always puzzled by the fact that he was unable to take it consistently. He wrote (1942): '*Oeneis macounii* Edw. has been taken only in a limited area at Victoria Beach where it flies at irregular periods among *Pinus banksiana*.

One year it may be abundant, and then it may not be seen for several years." The one thing that Brooks did not hit upon is the fact that *Oeneis macounii* has a biennial life-cycle and in eastern Manitoba it flies only in even numbered years. It can be found in forest glades among jack pines from mid- to late June. Masters and Sorenson (1967) provide more details on the bionomics of this insect.

Brush-footed butterflies:

NYMPHALIDAE

WHITE ADMIRAL *Limenitis arthemis arthemis* (Drury) Specimens from this part of Manitoba intergrade into subspecies *rubrofasciata* (Barnes & McDunnough), but I prefer to restrict the use of this name to populations from Riding Mountain, Manitoba and westward. This is a very conspicuous and common butterfly here. It is found from mid-June until the last of July, primarily in forested areas.

VICEROY *Limenitis archippus archippus* (Cramer) Local, preferring low marshy areas where willows grow. The Viceroy was recorded from Victoria Beach by Brodie. I have not taken it here but have encountered it in the Sandilands Forest Reserve.

RED ADMIRAL *Vanessa atalanta rubria* (Fruhstorfer) Scarce, but distributed throughout southern Manitoba in nearly every habitat situation. The butterflies are often found along dirt roads, alighting in the last patches of sunlight to hit the road late in the afternoon.

AMERICAN PAINTED LADY *Cynthia virginiensis* (Drury) This species is very abundant from late May until October in some years, but in others it is very scarce. It is a roadside butterfly and may be taken in nearly every type of habitat. I have even taken it in bogs.

PAINTED LADY *Cynthia cardui* (Linnaeus) This species does not overwinter in Manitoba and does not occur here at all in many years; in other years it may become extremely abundant. It is possible to find it during just about any summer month.

COMPTON'S TORTOISE SHELL *Nymphalis j-album j-album* (Boisduval & Le Conte) Through the years, Victoria Beach has received a reputation as being a good place to take this species. *N. j-album* has been quite easy to find throughout southeast Manitoba during the past six years. Could it be increasing in abundance? This is primarily a Canadian Zone forest species. It overwinters as an adult and is found in early spring and again from late July onward.

MILBERT'S TORTOISE SHELL *Nymphalis milberti milberti* (Godart) This species is more widespread than the previous, but never becomes quite as abundant in a favored locality. It is double-brooded, overwinters as an adult, and may be taken throughout the summer. It is most frequently found in marshy areas, although it is by no means restricted to them.

MOURNING CLOAK *Nymphalis antiopa antiopa* (Linnaeus) This is a well-known species that occurs throughout North America, Europe and Asia. I have not found *antiopa* as common as *N. j-album* in Manitoba, although *j-album* is a much more prized species. In the Belair Forest area the two species occur together.

COMMA *Polygonia comma* (Harris) I have found *P. comma* rather uncommon in this area. The adults, which overwinter, are found in deciduous forests in early spring and then in late summer and fall.

SATYR ANGLE-WING *Polygonia satyrus neomarsyas* dos Passos. This is the most abundant *Polygonia* species in the Manitoba prairie regions. I have found it fairly scarce at Belair. Adults overwinter and are taken in spring and late summer.

GREEN COMMA *Polygonia faunus faunus* (Edwards) Recorded from Victoria Beach by Brodie and Brooks. I have taken it in numbers at the Northwest Angle Provincial Forest and not uncommonly at Whiteshell and Sandilands. Like the other *Polygonia*, it is found in late summer with overwintering adults found in early spring.

P. faunus is at home in more boreal forest areas than the other *Polygonia* at Belair.

GRAY COMMA *Polygonia progne* (Cramer) This is the most abundant *Polygonia* in the Belair Forest. It is, at least partially, double brooded, a fact which produces a prolonged summer flight from July well into the fall months. Overwintering adults can be found in early spring.

PEARL CRESCENT *Phyciodes tharos tharos* (Drury) A very abundant multiple-brooded species here. *Phyciodes tharos* can be found in every habitat from late May until September.

BATE'S CRESCENT *Phyciodes batesii* (Reakirt) This is a sibling species to *P. tharos* which can only be identified by an experienced observer. Both Brooks and Brodie reported it from Victoria Beach. It should occur in this area but I have not observed it. I have taken it in fair numbers in the Sandilands Forest Reserve. Unlike *P. tharos, batesii* is single-brooded; it should be sought at the edges of bogs or in wet marshy areas in early July.

SILVERY CRESCENT *Chlosyne nycteis* Doubleday ssp. *C. nycteis* appears to be single - brooded here, although double-brooded in most parts of its range. Adults in mid- to late June.

HARRIS' CHECKERSPOT *Chlosyne harrisii* (Scudder) ssp. This species was recorded from Victoria Beach by both Brodie and Brooks. I have not taken it here.

HANHAM'S CHECKERSPOT *Chlosyne hanhami* (Fletcher) This species, the principal range of which is southern Manitoba, has been regarded as a subspecies of *Chlosyne harrisii.* I believe them to be separate species, for *hanhami* is considerably larger than *harrisii* and inhabits more open areas, prefering prairies, while *harrisii* is found in more wet marshy areas.

SILVER BORDERED FRITILLARY *Boloria selene atrocostalis* (Huard) A common double-brooded species of marshy areas. A first brood in early June and a second brood in late July.

MEADOW FRITILLARY *Boloria bellona* nr. *toddi* (Holland) More widespread in occurrence than *B. selene* but not so common locally, *B. bellona* is found along roadsides in pastures and in meadows. A first brood in late May and a second one in July.

BOG FRITILLARY *Boloria eunomia dawsoni* (Barnes & McDunnough) Both Brooks and Brodie have reported this species from Victoria Beach. I have taken it in Whiteshell Provincial Forest, but not elsewhere in southeast Manitoba. The species is a bog obligate and occurs only in pure sphagnum bogs. It should be looked for in mid-June to early July.

ATLANTIS FRITILLARY *Speyeria atlantis atlantis* (Edwards) The commonest *Speyeria* in this area, it is usually abundant from late June until the middle of August. When they first emerge, the adults are for the most part confined to areas along the edges of the forest or in forest lanes, but by July they can be found visiting flowers wherever these are to be found.

GREAT SPANGLED FRITILLARY *Speyeria cybele cybele* (Fabricius) Not so common as *Speyeria atlantis* in this locality and more prone to fly in more open country away from forests.

APHRODITE FRITILLARY *Speyeria aphrodite* (Fabricius) ssp. The scarcest *Speyeria* in this area. Flies with *S. atlantis* and distinguished from them (in these populations) with difficulty.

CALLIPPE FRITILLARY [*Speyeria callippe calgariana* McDunnough] Recorded from Victoria Beach by Brooks (1942). A very unusual record if authentic. Until such time as this record can be confirmed, it is better to leave this species off the Grand Beach list.

Blues, Coppers and Hairstreaks: LYCAENIDAE

BRONZE COPPER *Lycaena thoe* Guerin-Meneville Not common, but widespread in many habitats. Found from late July until early September.

GREAT COPPER *Lycaena xanthoides dione* Scudder Recorded from Victoria Beach by Brooks. This species is usually associated with native prairie areas and other open lands where its larval foodplant, bitter dock *(Rumex obtusifolius)*, occurs. Colonies are common in the Winnipeg area.

PURPLISH COPPER *Lycaena helloides* (Boisduval) This is a roadside butterfly that is found sporadically in late summer in nearly any habitat. Both Brooks and Brodie recorded it at Victoria Beach.

COMMON BOG ELFIN *Incisalia augustinus augustinus* (Westwood) This species is very common and widespread in bogs, although not restricted to them. Before lepidopterists learned to seek it in bogs, it was regarded as very rare in Manitoba. It flies from mid-May until mid-June, primarily in bogs, but sometimes in other habitats such as sandy soiled areas where *I. polios* occurs.

HOARY ELFIN *Incisalia polios* Cook & Watson A local species that is very well adapted along La Petit Montagne de Cypres. It occurs on sandy soils where its foodplant, bearberry *(Arctostaphylos uva-ursi)*, grows. It is an early flier and should be sought during the last week of May. There is one locality in the Sandilands Provincial Forest where it may be taken by the hundreds.

PINE ELFIN *Incisalia niphon clarki* Freeman This species is found in the vicinity of its larval foodplant, jack pine *(Pinus banksiana)*, in late May or early June. It does not appear to be found in large numbers in this area.

STRIPED HAIRSTREAK *Satyrium liparops fletcheri* (Michener & dos Passos) This is the only hairstreak that has been recorded from Belair, though several others could possibly occur here. *Satyrium l. fletcheri* can be distinguished by the presence of conspicuous orange-brown patches on the upper forewings and, frequently, on the hindwings as well. It occurs along roadsides, in pastures and old fields from late July to mid-August. Adults are avid flower visitors.

NORTHERN BLUE *Lycaeides argyrognomon* manuscript subspecies Masters This is a very local species of woodland habitats. It was recorded from Victoria Beach by both Brooks and Brodie. I have not taken it here. Adults should be sought in mid-July.

MELISSA BLUE [*Lycaeides melissa melissa* (Edwards) This species was recorded from Victoria Beach by both Brooks and Brodie. It could occur here, but I suspect that they were confusing the two sexes of *L. argyrognomon* as distinct species. *Lycaeides melissa* very closely resembles *L. argyrognomon* but is found in prairie habitats instead of forests. *Lycaeides melissa is* abundant in the Winnipeg area.

GREENISH BLUE *Plebejus saepiolus saepiolus* (Boisduval) A fairly common species along roads or in open woodlands. Adults from mid-June until mid-July.

EASTERN TAILED BLUE *Everes comyntas comyntas* (Godart) Brooks did not record *E. comyntas* for Manitoba at all; however, he and Brodie both recorded *Everes amyntula* for Victoria Beach. I have found both species together at Sandilands, with *comyntas* more abundant but have found only *comyntas* at Belair. I do not know whether Brooks failed to make the distinction between these two species or whether *E. comyntas* is of recent occurrence in southeast Manitoba. *Everes comyntas* is multiple brooded and adults can be found throughout the summer from late May to late August.

WESTERN TAILED BLUE *Everes amyntula albrighti* Clench Recorded from Victoria Beach by Brodie and Brooks; I have taken it at Sandilands and Whiteshell, but not in this area. It should occur here. I am not certain whether the Brodie-Brooks records are correctly identified or not (see comments under *E. comyntas*). Unlike *E. comyntas, E. amyntula* is single-brooded; adults should be sought in early July.

SILVERY BLUE *Glaucopsyche lygdamus couperi* Grote A common early season species of woodland areas. Adults are found from mid-May to late June.

SPRING AZURE *Celastrina argiolus argentata* Fletcher I am not certain about the subspecific designation with this species; *argentata* was described from Cartwright, Manitoba but most eastern Manitoba populations show a degree of intergradation between *argentata* and *pseudargiolus*. This is one of the first butterflies on the wing in the spring; there is a first brood in May and a second brood in early July.

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A LIST OF BUTTERFLIES TAKEN AT SANDILANDS PROVINCIAL FOREST, MANITOBA

by **John H. Masters,** P.O. Box 7511, St. Paul, Minnesota

Sandilands Provincial Forest comprises the southern Manitoba segment of La Petite Montagne de Cypres (or Sandilands Ridge) which extends from Victoria Beach on Lake Winnipeg through the Belair, Agassiz and Sandilands Forest Reserves into Roseau County, Minnesota. This entire ridge was formed as a beach from wave action on glacial Lake Agassiz 12,000 years ago. The area is characterized by shallow sandy soil (hence the name sandilands) and mixed deciduous-coniferous forests. Unlike the areas of Manitoba to the west of this ridge, this land has not been cultivated in the past and is now in the public domain as Provincial Forest. The forests have not been cut over for many years and the forest reserve is cut by numerous fire control roads. It is an excellent area for natural history studies.

For the past six years I have been studying butterfly distribution in Manitoba and have recently started to write a series of articles dealing with Manitoba Provincial Parks. The second of these (Masters, 1972) deals with the butterflies of Grand Beach Provincial Park and Belair Forest Reserve which is the northern segment of La Petite Montagne de Cypres. Because I have spent considerably more time working in Sandilands than in the Belair Forests, I have a much more complete list of the butterflies occurring here. It would seem worthwhile, therefore, to list the species recorded from Sandilands. This list follows. Species that are marked with an asterisk have not been taken by me but have been taken by others or recorded elsewhere as occurring at Sandilands.

PAPILIONIDAE:

Papilio polyxenes asterius Stoll*, *Papilio glaucus canadensis* Rothschild & Jordan.

PIERIDAE:

Pieris protodice protodice Boisduval & LeConte, *Pieris napi oleracea* Harris, *Pieris rapae rapae* (Linnaeus), *Colias eurytheme eurytheme* Boisduval, *Colias philodice philodice* Godart, *Colias interior interior* Scudder, *Eurema lisa* (Boisduval & LeConte), *Nathalis iole* (Boisduval), *Euchloe ausonides* Lucas ssp.

DANAIDAE:

Danaus plexippus plexippus (Linnaeus).

SATYRIDAE:

Lethe anthedon borealis (Clark), *Lethe eurydice eurydice* (Johansson), *Euptychia cymela cymela* (Cramer), *Coenonympha tullia inornata* Edwards, *Cercyonis pegala nephele* (Kirby), *Erebia* *disa mancinus* Doubleday*, *Erebia discoidalis discoidalis* (Kirby), *Oeneis uhleri varuna* Edwards*, *Oeneis macounii* (Edwards), *Oeneis jutta ascerta* Masters & Sorensen*.

NYMPHALIDAE:

Limenitis arthemis arthemis (Drury), *Limenitis archippus archippus* (Cramer), *Vanessa atalanta rubria* (Fruhstorfer), *Cynthia virginiensis* (Drury), *Cynthia cardui* (Linnaeus), *Precis coenia coenia* (Hubner)*, *Nymphalis j-album j-album* (Boisduval & LeConte), *Nymphalis antiopa antiopa* (Linnaeus), *Nymphalis milberti milberti* (Godart), *Polygonia interrogationis* (Fabricius)*, *Polygonia satyrus neomarsyas* dos Passos, *Polygonia progne* (Cramer), *Phyciodes tharos tharos* (Drury), *Phyciodes batesii* (Reakirt), *Chlosyne nycteis* Doubleday ssp., *Chlosyne harrisii* (Scudder) ssp.*, *Chlosyne hanhami* (Fletcher)*, *Boloria selene atrocostalis* (Huard), *Boloria bellona* nr. *toddi* (Holland), *Boloria titania grandis* (Barnes & McDunnough), *Boloria frigga* (Thunberg) ssp.*, *Speyeria atlantis atlantis* (Edwards), *Speyeria atlantis* nr. *dennisi* dos Passos & Grey, *Speyeria cybele cybele* (Fabricius), *Speyeria aphrodite* (Fabricius) ssp., *Euptoieta claudia claudia* (Cramer).

LYCAENIDAE:

Incisalia augustinus augustinus (Westwood), *Incisalia henrici henrici* (Grote & Robinson), *Incisalia polios* Cook & Watson, *Incisalia eryphon* (Boisduval) ssp.*, *Incisalia niphon clarki* Freeman, *Harkenclenus titus titus* (Fabricius), *Satyrium acadica* (Edwards), ssp.*, *Satyrium liparops fletcheri* (Michener & dos Passos, *Feniseca tarquinius tarquinius* (Fabricius)*, *Lycaena thoe* Guerin-Meneville*, *Lycaena xanthoides dione* Scudder, *Lycaena helloides* (Boisduval)*, *Lycaena dorcas* Kirby ssp., *Lycaena epixanthe* (Boisduval & LeConte) ssp., *Plebejus saepiolus saepiolus* (Boisduval), *Everes comyntas comyntas* (Godart), *Everes amyntula albrighti* Clench, *Glaucopsyche lygdamus couperi* Grote, *Celastrina argiolus argentata* Fletcher.

I am indebted to C. S. Quelch of Transcona, Manitoba, who introduced me to collecting at Sandilands on my first collecting trip to Manitoba in 1966. With Mr. Quelch's guidance I located a rich colony of *Oeneis macounii* at Sandilands and was so intrigued by their habitat and habits that I launched my studies on the butterflies of Manitoba as well as a series of studies dealing with bionomics of *Oeneis*.

Good collecting can be found at Sandilands all summer. By the end of May, four species of *Incisalia* are fairly abundant along with *Euchloe ausonides*, *Erebia discoidalis* and *Glaucopsyche lygdamus;* by mid-June *Oeneis macounii*, *Limenitis arthemis* and *Papilio glaucus* are out in numbers; early July brings out *Colias interior*, *Phyciodes batesii*, and the *Speyeria* species; and August provides the *Nymphalis* and *Polygonia* species, *Boloria titania*, and *Satyrium liparops.*

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EPIPHYTIC ALGAE ISOLATED FROM MOSS

by **D. R. Cullimore and A. E. McCann,** University, Regina

In the prairie region, mosses are commonly found growing on river and creek banks and also on the open prairie. As a part of the I.B.P. project at Matador, Saskatchewan, attempts were made to evaluate the role of these mosses in the ecological balance of native grassland. Paul, Campbell, Hedlin and Lees (1972) reported that the leaves of one specific moss, *Ceratodon purpureus* had a high nitrogen fixing capacity of 0.02 to 1 microgram of nitrogen per hour and that fixation was light and moisture dependent. Samples of moss from Matador and similar samples from Saskatoon possessed this property. In this study, the moss samples were examined for the presence of any algae which could have been responsible for this fixation of nitrogen.

Method

0.4 gram of moss samples were weighed and suspended in 3.6 ml. of a nutrient solution which contained all of the elements for algal growth except nitrogen. The medium was developed by Cullimore and McCann (1972A) for the isolation and enumeration of the blue-green algae *(Cyanophyceae)* in soil. The moss was now shaken in suspension to disperse any algal cells attached to the plant. Serial dilutions of this suspension were made into the same nutrient medium using 0.4 ml. transfers into 3.6 ml. of media by the aseptic techniques described by Sirockin and Cullimore (1969). This technique diluted out the original suspension until all algae would be eliminated. All of the levels of dilution were now left in white fluorescent light at 20°C to allow growth of any algae present. After twelve weeks, each dilution level was examined for the types of algae present, and their numbers were calculated. This was done by presuming that the number of algae present was equivalent to the greatest dilution at which the algae appeared. This technique is discussed in detail by Cullimore and McCann (1972B).

Table 1. Algal Population on *Ceratodon purpureus* (cells/gram-wet weight).

Genus	Potential Nitrogen Fixers	Saskatoon Sample	Matador Sample
Nostoc	+	100,000+	1,000+
Lyngbya	—	10,000+	0
Oscillatoria	—	1,000+	0
Chlorella	—	100+	0
Pinnularia	—	100	0
Spongiochloris	—	10+	10
Calothrix	+	100+	0
Anabaena	+	0	1,000+
Mesotaenium	—	0	10
Diatoms	—	0	10+

Results

Nine genera of algae were recorded on the moss samples and their population per gram is recorded as Table 1. Only one genus, *Nostoc*, was found to be present in significant numbers on both moss samples and it has been shown to fix nitrogen in large amounts. Other nitrogen fixing blue-green algae were also found on the moss samples. The sample from Saskatoon contained a few filaments of *Calothrix*, whilst the sample from Matador was rich in *Anabaena*. Since mosses have never been reported to be capable of fixing atmospheric nitrogen, it would appear that some form of symbolic relationship may exist between these algae (principally *Nostoc*) and the moss plant. In this relationship the algae may fix sufficient nitrogen to supply the moss with at least a part of its nitrogen requirements, and in return the moss would provide nutrients, water and protection for the algae. The high rates at which atmospheric nitrogen is fixed by the leaves in light would imply that the nitrogen fixed this way could contribute significantly to the nitrogen balance in the unique ecosystem of the native prairie grasslands.

Acknowledgments

The authors wish to thank Dr. E. A. Paul of the Soil Science Dept. University of Saskatchewan, for provision of samples and the I.B.P. program for sponsoring this project.

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A BOTANICAL INVESTIGATION IN THE DRUMHELLER AREA, ALBERTA

by **Harold W. Pinel**, 1017 - 19th Avenue, N.W. and
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INTRODUCTION

Drumheller, located in the Red Deer River Valley sixty miles east-northeast of Calgary in the Mixed Grassland vegetation zone of southern Alberta, is probably best known for its hot, dry climate and its rugged badlands which have been created by intensive erosion. The region is curiously interesting because of biological and topographical features which contrast strikingly with the surrounding cultivated plain. The landscape is sharply dissected by numerous coulee systems that lead into the valleys of the Rosebud River, Kneehills Creek, and Red Deer River. The topography of these coulees creates a great diversity of vegetation types. For example, in this arid region, located approximately 75 miles east of the coniferous foothills forest and 110 miles south of the northern boreal forest, there is an abundance of white spruce *(Picea glauca)* on slopes which have more favorable moisture regimes.

Strangely enough, little biological work has been carried out in the area. Brief notes on the fauna of the region were made by Taverner in 1919 and Soper in 1964. The avifauna of the area was more intensively studied by Salt (1938, 1939, 1950, 1958, 1966). Moss and Campbell (1947) and Moss (1955) made brief references to the flora of this area. Preliminary analyses of the flora of the Drumheller region were carried out by Bird (1962, 1971).

Therefore, in view of the paucity of information on the botany of the Drumheller area, the authors analyzed the vascular and non-vascular flora during 1971 in order to catalogue the plant species found there and to consider them as components of the various vegetation types.

HISTORY OF THE AREA

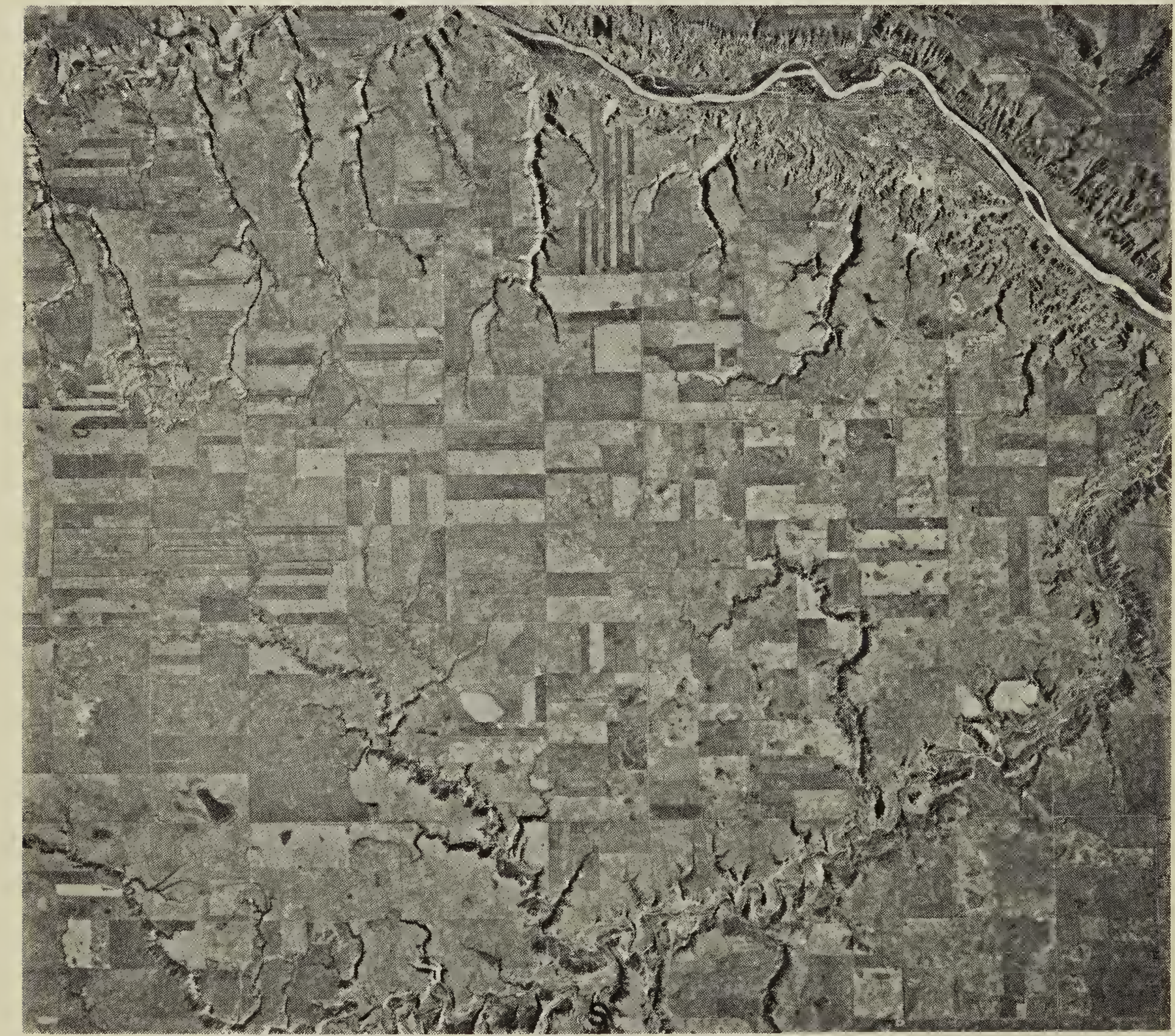
Prior to the white man's invasion, both Blackfoot and Cree Indian tribes occupied the area which, because of the abundance of deer and buffalo, was prime hunting ground. The steep cliffs of the coulees and river valleys afforded numerous excellent buffalo jumps. So abundant was saskatoon *(Amelanchier alnifolia)* that the Cree named the Rosebud River, "Misaskatoomina Sipisis" (Saskatoon Creek).

The first white man known to enter this area was Fidler who, in 1793, crossed the Red Deer River at its junction with the Rosebud River (Tyrell 1886). He remarked on the great quantities of coal present along the Rosebud River, a fact which prompted him to name it "Edge Coal Creek". These and other coal deposits were instrumental in the development of mining operations in the early 1900's although few still persist. In the spring of 1858, Captain John Palliser reached a part of the Rosebud River near its eastern end (Palliser 1863). Macoun followed shortly thereafter (Macoun 1882). Both Macoun and Palliser remarked on the arid appearance of the region. Tyrell, in 1886, was the first person to note the occurrence of white spruce. Commenting on the eastern portion of the Rosebud River, he writes, "the banks become very precipitous and the lateral coulees are filled with a thick growth of spruce." With the discovery of excellent quality dinosaur bones and skeletons, a number of "fossil-hunters" were attracted to the area (Sternberg 1917).

The first settlers in the area were ranchers who arrived in 1885. Martin (1963) in a discussion of the history of the Rosebud district writes, "The ranchers had their day, then the lowly plough took over turning the vast prairie wrong-side-up". As a result of poor farming practices, the area became a dust bowl during the 1930's. Nowadays, the area is still extensively cultivated with the coulees and river valleys being the sole refugia for native or semi-native vegetation (Fig. 1). In the proximity of the study area, the only sizeable uncultivated areas remaining lie to the east along the escarpment of the Hand Hills and to the southeast along the north slopes of the Wintering Hills.

DESCRIPTION OF THE STUDY AREA

The area sampled centered around 51° 25′ N Lat. and 112° 50′ W Long., and included the lower reaches of the Rosebud River valley and Kneehills Creek valley and also incorporated that portion of the Red Deer River valley lying between them (Fig. 2). More specifically, the Rosebud River and Kneehills Creek were sampled from the towns of Rosebud and Hesketh respectively, eastward to their junctions with the Red Deer River. The coulees leading from the three major streams were also sampled. Collecting sites are indicated in Figure 2. It should be noted that no collections were made outside the coulees and river valleys because all other areas were under intensive cultivation. It is difficult to determine precisely the number of square miles or acres covered by the study. Throughout this area, the coulees and valleys averaged about one-quarter of



Air Photo A21757, Dept. Energy, Mines and Resources

Fig. 1. Study area showing extensive cultivation. Red Deer River in upper right (NE) corner. Scale, 2⅔ miles per inch.

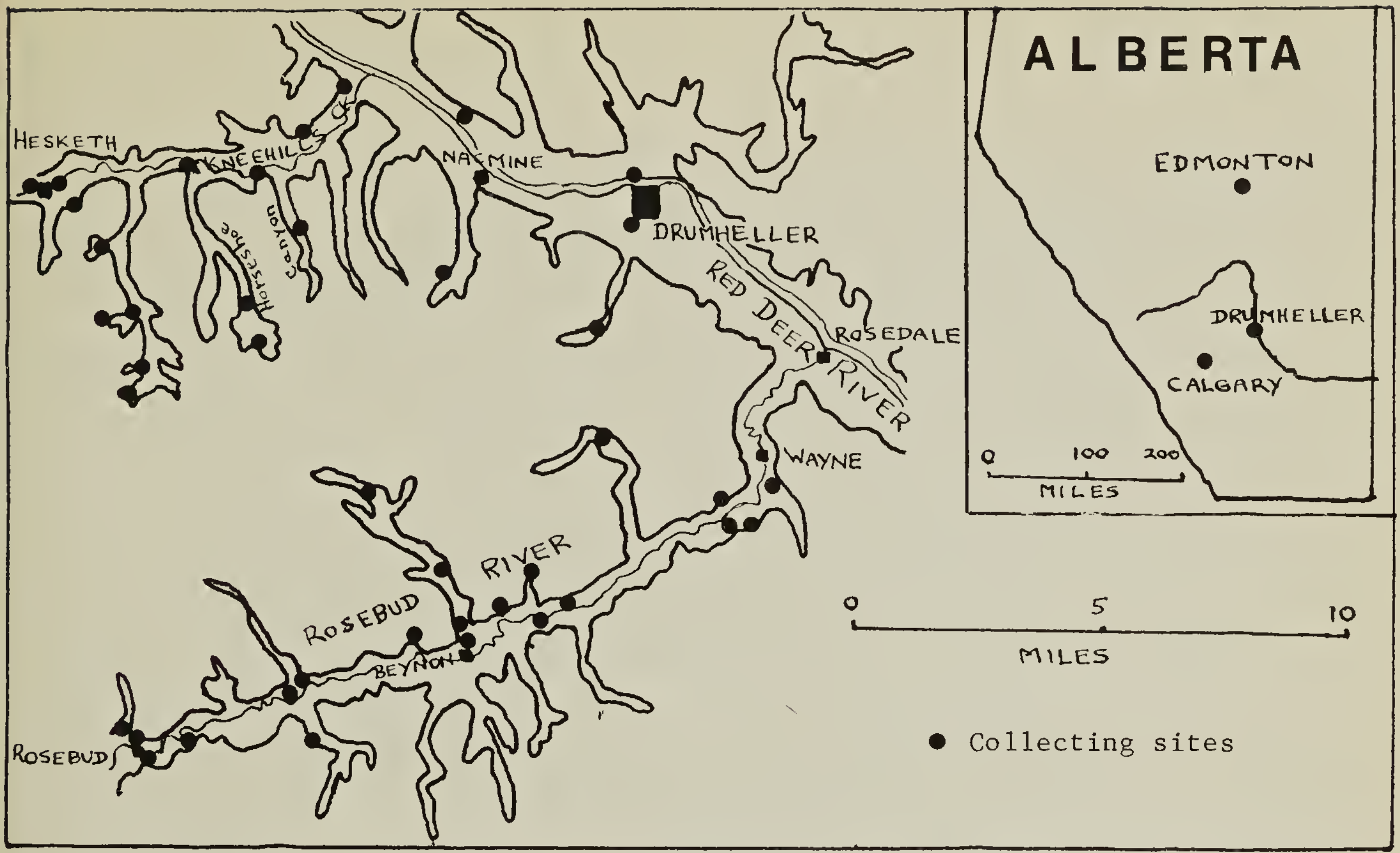


Fig. 2. Map of the study area showing collecting sites.

a mile in width and, end to end, their total length would be approximately 110 miles, giving an area of about 30 square miles.

PHYSIOGRAPHY AND GEOLOGY

The most striking aspect of the area is the river valleys and numerous coulees which cut deeply into the flat landscape. Located within the wider valleys, there is an abundance of bare conical buttes and other formations produced by erosion which give the area a badland appearance. The coulees generally run in a north-south direction and range from deep, narrow gorges (Fig. 3) to shallow, broad valleys with gently sloping sides (Fig. 4). Creeks within these coulees empty into either the Rosebud River or Kneehills Creek which in turn empty into the Red Deer River approximately ten miles apart. No permanent lakes exist in the area, although numerous temporary alkaline sloughs are scattered throughout the cultivated fields. A few springs are located within the coulees (Martin 1963, 1967).

Near Drumheller, the Red Deer River varies in width from 100 to 200 yards; its bed is usually sandy, and sand-bars and sandy islands occur at intervals. The depth of its valley ranges from 300 to 450 feet, and its width approximates one mile. Near their junctions with the Red Deer River, the Rosebud River and Kneehills Creek are similar, each having steep gorges up to 400 feet in depth. Here, both streams average 30 feet in width in mid-summer. Further upstream, the gorges give way to more gently rolling sides, the width of their valleys ranging from one-half to three-quarters of a mile.

The cliffs that flank the three major streams are composed of many coloured layers of varying thickness and composition which give these bare cliffs a highly variegated and picturesque appearance. These strata were termed "Banded Clays" by Dr. Hector of the Palliser expedition. The softness of these strata makes them very susceptible to erosion, a fact which is illustrated by the numerous steep coulees and badland features present (Fig. 5). Dawson (1884) writes, "the ramifications of the coulees, upon uniting, gradually detach small portions of the plateau, and leave these an easy prey to the degrading influence of sub-aerial erosion, by the agency of which they have been sculptured into dome and pyramid, scarp and terrace and all the endless variety of form characteristic of the badlands of the West".

Surface deposits underlying the cultivated plains of the Drumheller area are of two major types (Craig 1957). Clay lake deposits are the most widespread and range to fifty feet in thickness. These were laid down in Lake Drumheller (which occupied about 1100 square miles) during deglaciation which occurred approximately 15,000 years ago. The other type of surface deposit is a clayey till left as a ground moraine by glacial ice of northeastern origin.

In the coulees and valleys bedrock is exposed. These strata belong to the Edmonton Group which is Late Cretaceous in age. This group is non-marine and was formed by deposition of sediments in deltaic, estuarine and flood plain environments. Fine-grained argillaceous sandstones, siltstones, sandy shales, shales with intermixed ironstone layers, calcareous sandstones, carbonaceous shales and coal are typical of the Edmonton Group (Irish 1967, 1970). Bentonite is an important component of the sediments and forms bentonitic clays, shales and sandstones.

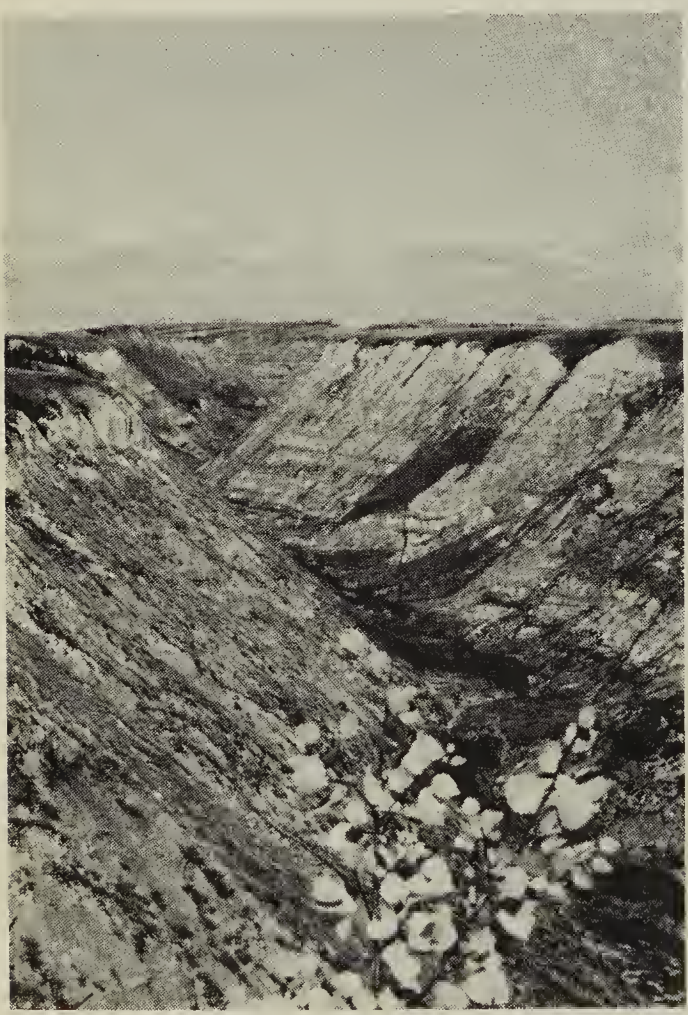


Fig. 3. Deep, narrow gorge as seen looking north toward Nacmine. The spruce trees at the top of the gorge on the left side average 30-40 feet.

SOILS

The study area is located entirely within the Dark Brown Soil Zone. This is a narrow zone situated between the Light Brown Soil characteristic of the short-grass prairie to the south and the Black Soil of the aspen parkland to the north. There is a shallow phase of the Black Soil zone in isolated areas on the western fringe of the study area. Soils of the area are non-saline, have a pH of about 7.5, contain very few rocks, and are generally clayey. However, they range from light to heavy clays to clay loams to silt loams (in a few areas) and from heavy to light loams along the river valleys (Wyatt *et al.* 1943).

CLIMATE

The climate of the Drumheller region is of the continental type, characterized by relatively long cold winters and short hot summers. It is a climate which exhibits wide fluctuations, daily and annually. The prevailing winds are westerly. This area lies on the northern edge of the main chinook belt of southern Alberta. The warm, dry chinook winds bring about significant warming of temperatures. Their duration may be a few hours or several days. During the winter they are able to melt and evaporate considerable amounts of snow, thereby decreasing spring runoff. Precipitation and temperature for the area have been recorded at Rosedale since 1914 and at Drumheller since 1924.

The area has a relatively cool mean annual temperature of 36° F with an average yearly maximum of 48° F

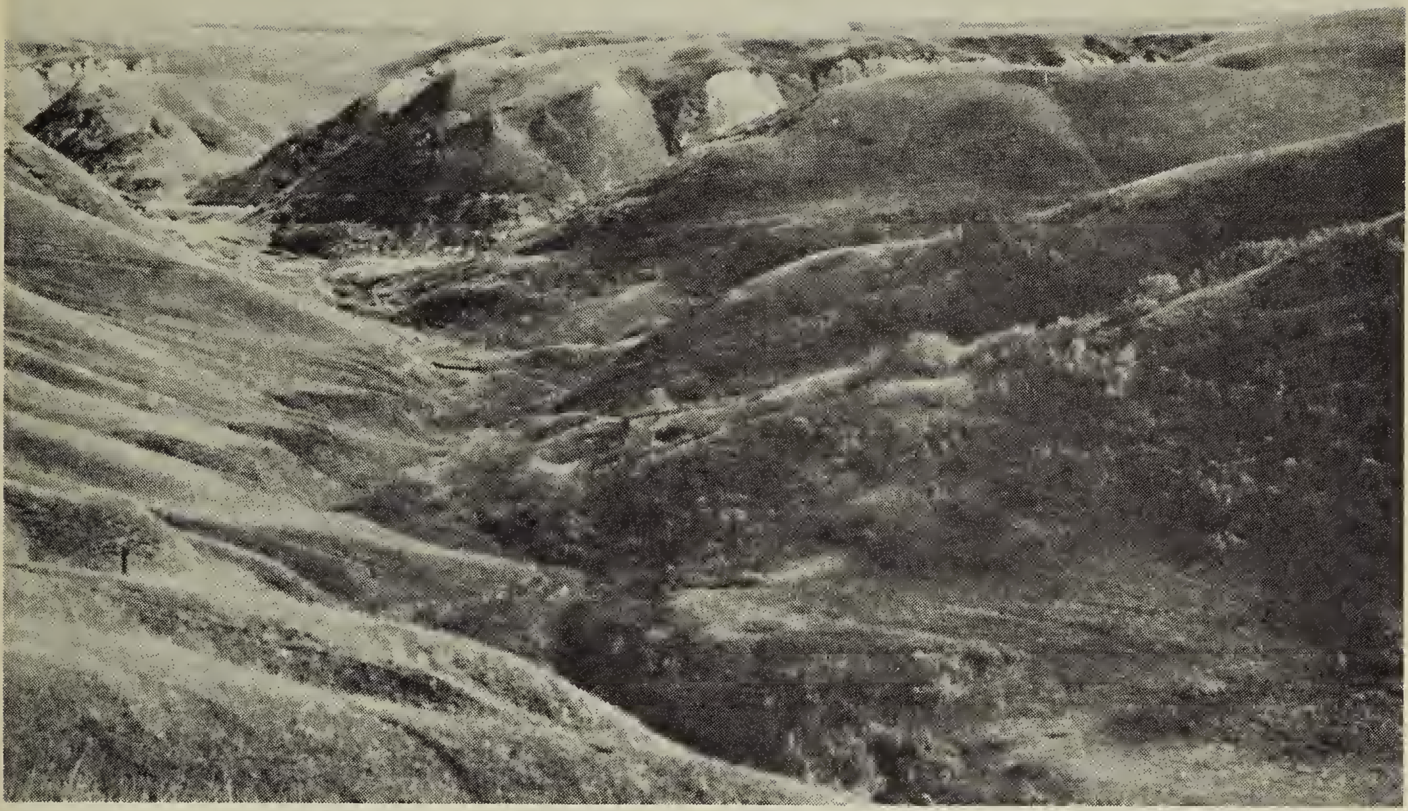


Fig. 4. Shallow, broad valleys as seen 1 mile west of Nacmine. It is on this type of terrain that the greatest development of grassland occurs.

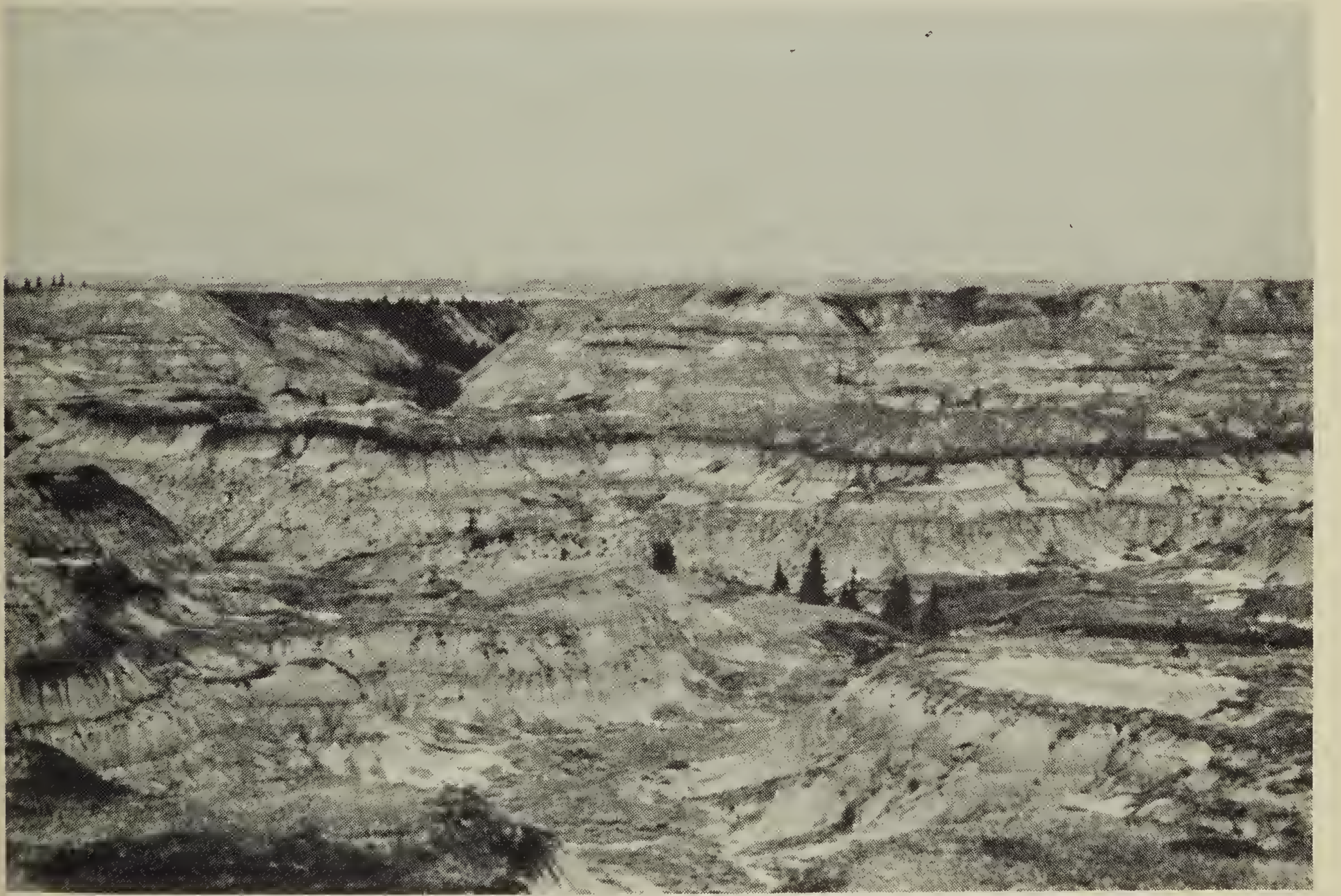


Fig. 5. Horseshoe Canyon, showing the badland terrain. The underlying exposed strata are of the Edmonton group.

and minimum of 24° F. July is the hottest month and January the coldest (Fig. 6). The average frost free period is 110 days. However, there is a wide variation with the longest frost free period being 147 days and the shortest 71 days. The earliest fall frost recorded was on August 19 and the latest on October 4. The latest known spring frost fell on June 18 (Met. Div., Dept. Trans. 1956).

The average annual precipitation is between 12 and 14 inches, decreasing from west to east. Over 70% of the precipitation falls as rain. Approximately half the precipitation occurs from June to August (Fig. 6). Cyclonic activity creates a considerable amount of the summer rainfall. Periodically, this region is subject to drought, for example, in the 1890's (Martin 1967) and in the 1930's (Wyatt *et al.* 1943). At the other extreme, severe spring flooding occurs frequently, for example, in 1899, 1904, 1920, 1931, and 1948 (Martin 1963). Floodwaters have been known to cover large areas in the Rosebud River valley. The combination of the great volume of spring meltwaters and the huge mobile ice-blocks has often broken up train trestles along both the Rosebud River and Kneehills Creek. By the end of summer, howeven, the volumes of water in these streams have been drastically reduced.

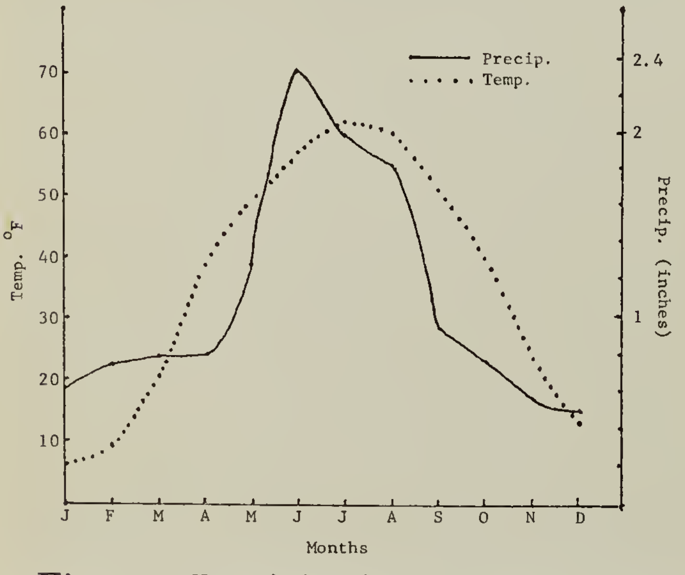


Fig. 6. Precipitation - temperature regimes for the Drumheller area (Climatology Div., Meteor. Branch, Dept. Transp. 1964 & 1965).

As a result of the irregular topography, a considerable microclimatic effect is evident in the coulees. The north- and east-facing slopes have more favourable moisture regimes. These slopes receive less solar radiation, and consequently have lower evaporation, and longer snow duration than the southerly-facing slopes. Moisture conditions are reflected in the vegetation patterns which will be discussed later.

MINOR FACTORS INFLUENCING VEGETATION

An assortment of minor factors influence the vegetation.

Although probably important in former times, fire presently plays a minor role in determining the extent of the major vegetation types within the coulees. It is possible that, following fires, the boundaries of the various vegetation types could be extended or diminished. However, it is difficult to ascertain the effects of fire at the present time because there have been no fires in the area for 66 years. The last major fire, which occurred in 1905, burned the entire ridge between the Rosebud River and Kneehills Creek from Rosebud to Drumheller (Martin 1963).

On the steeper slopes, a fairly important factor is the occurrence of slumping. This process affects very small areas as well as entire hillsides. Although most noticeable in grasslands and dry eroded areas, slumping has been observed in dense spruce forests. On the steepest slopes, the result may be the destruction of the vegetation.

Native mammals have little influence on the vegetation. Porcupines strip the bark of deciduous trees and shrubs, and there is evidence of browsing and grazing by deer, but the overall effect is minor.

The steep sides of the majority of the coulees have long prevented man from entering and utilizing them. Nevertheless, in the more accessible areas considerable damage has resulted. Where cattle have access, severe trampling and grazing occur. The grassland, while appearing like freshly mowed lawns, suffers to a lesser degree than do the forested areas. Complete eradication of the ground cover occurs in many of the wooded areas and weeds often invade these areas to the exclusion of the native flora.

VEGETATIONAL ANALYSIS

There are four major vegetation types occurring within the coulees and river valleys: sageland, grassland, thickets, and forested areas. The extent of the various vegetation types varies considerably within each coulee. Abrupt demarcations often exist even to the extreme of having dense stands of white spruce bordering bare sageland (Fig. 7). Where the topography is not so steep, gradual transitions of the vegetation are common (Fig. 8). This variety provides the area with exceptional beauty. The various vegetation types and their characteristic species will be discussed. It should be noted, however, that because of the abrupt zonations occurring over short distances there is an overlap of species between each vegetation type. For example, prairie anemone *(Anemone patens* var. *wolfgangiana)* has been observed growing in the moss carpet of dense spruce woods.

Sageland

Because of the forces of erosion and climate, extensive bare areas have been produced which are favorable only for sageland. This sparse type of vegetation occurs on the steep south-facing slopes, the periphery of buttes, and the higher borders of the valley bottoms (Fig. 9). These areas are dominated by sagebrush *(Artemisia cana)* averaging 2 - 3 feet in height.

Characteristic associated species include *Atriplex nuttallii*, *Artemisia longifolia*, *Eurotia lanata*, *Gutierrezia sarothrae*, and *Aster canescens*. A common soil lichen of these bare areas is *Parmelia chlorochroa*.

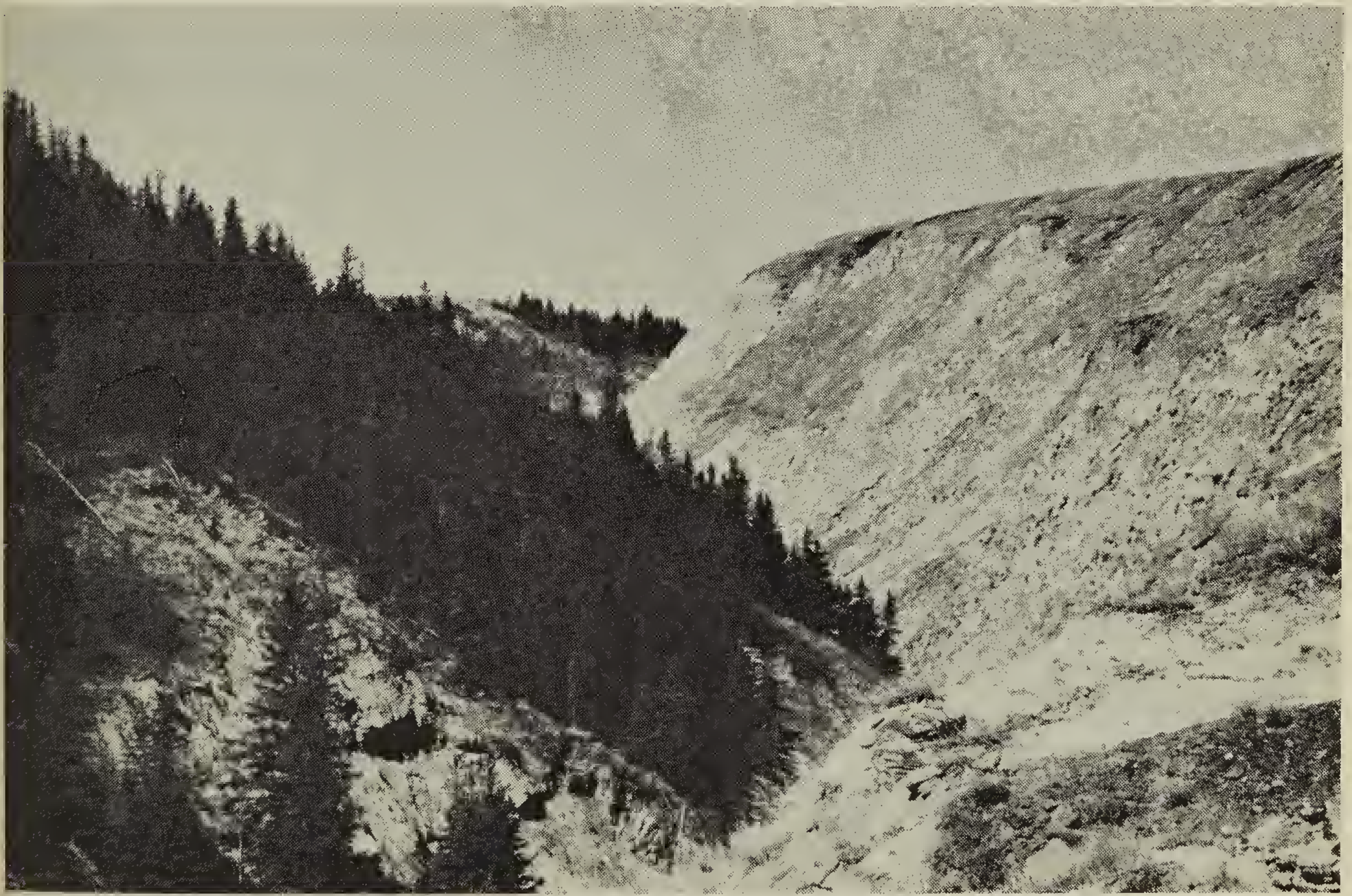


Fig. 7. North end of Horseshoe Canyon, showing the abrupt transition between the dense white spruce stand and the bare area dominated by sagebrush. Here, the spruce are on an east-facing slope.

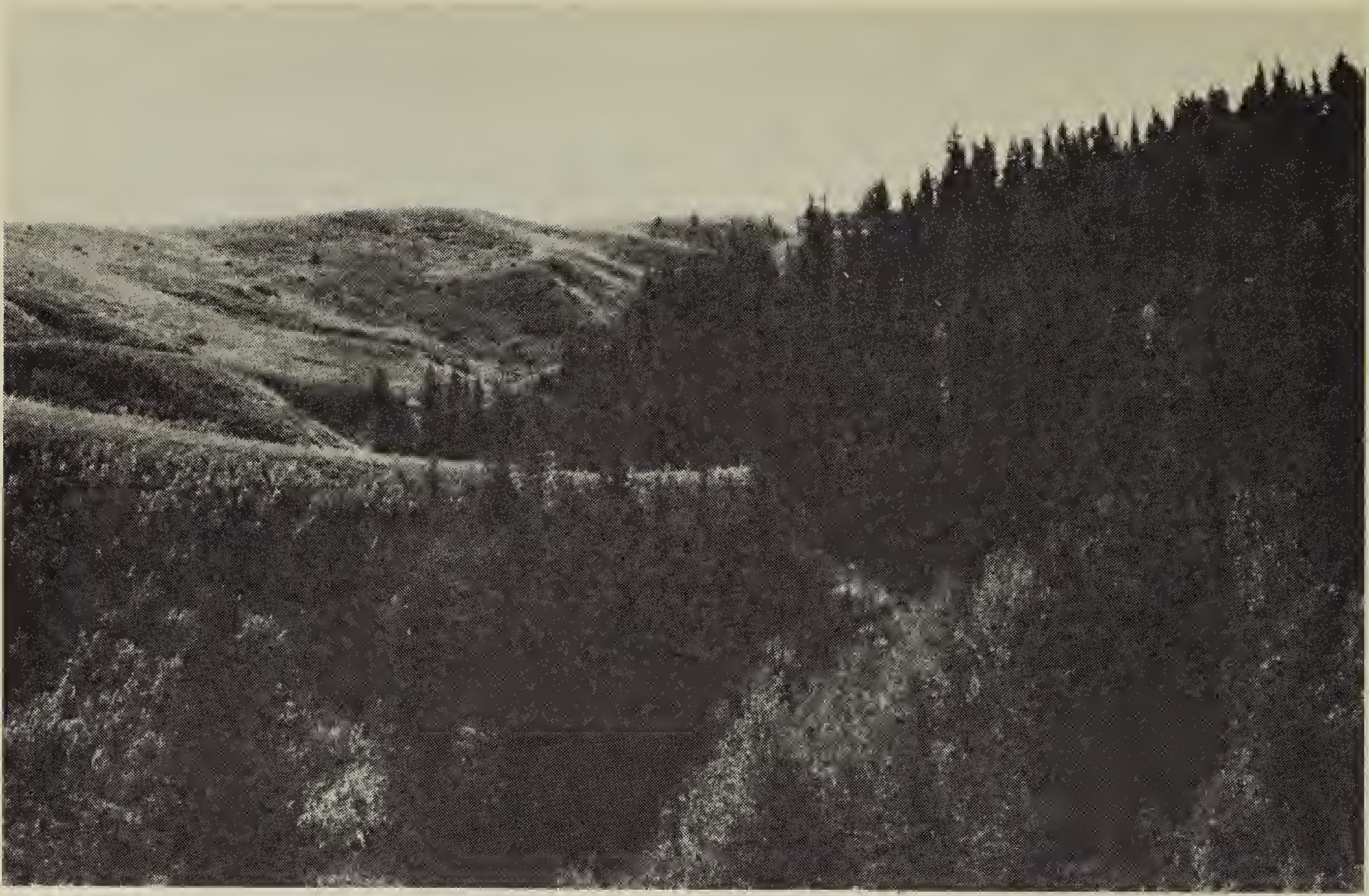


Fig. 8. The area four miles northwest of Beynon, illustrating the gradual transition from white spruce (upper right) to aspen (lower right) to shrubs (centre left) to mixed grasses (upper left). The spruce are on a northeast-facing slope.

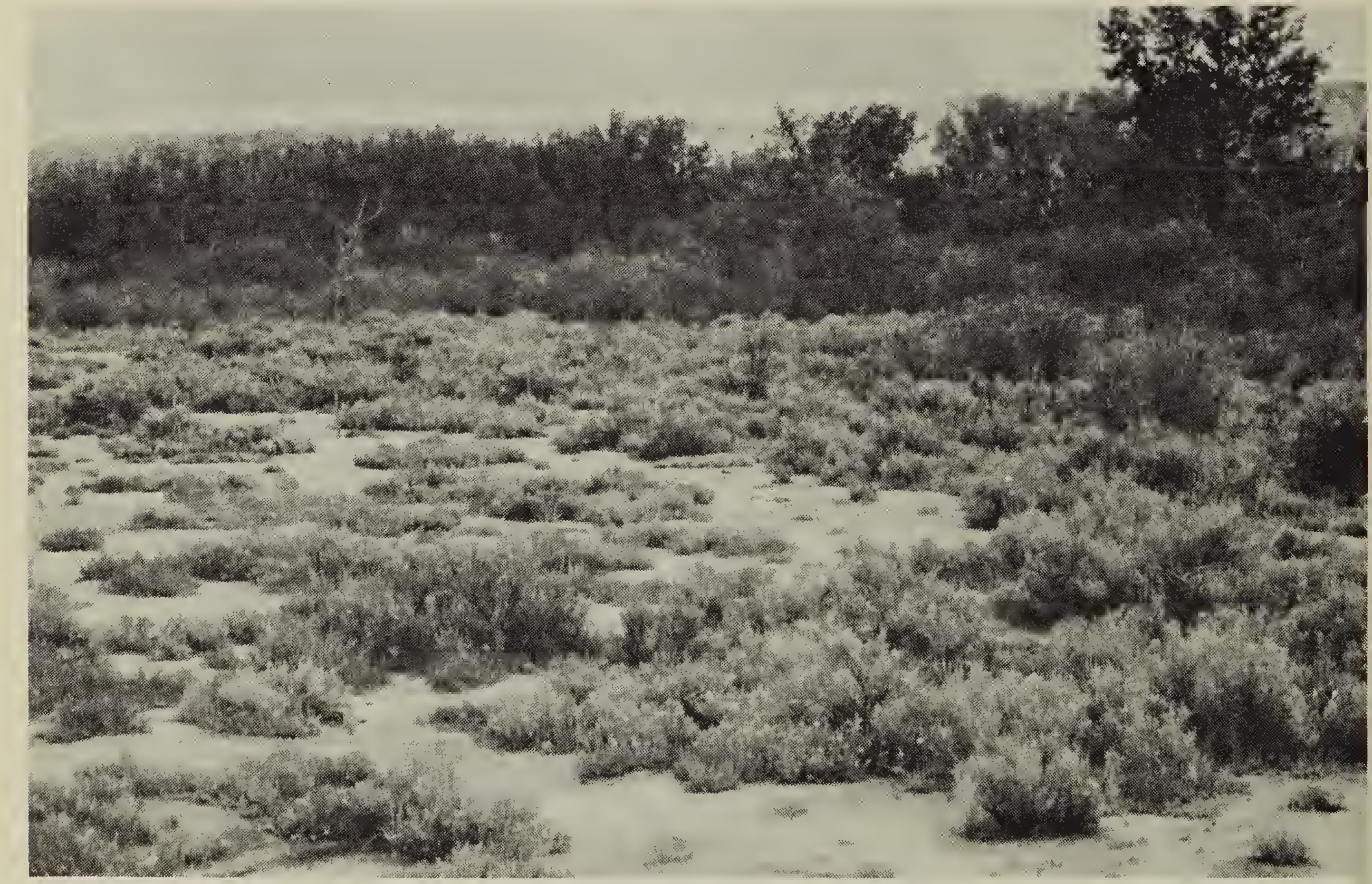


Fig. 9. Sageflat at the junction of Kneehills Creek and Red Deer River. The bare sageland is dominated by *Artemisia cana* and *Atriplex nuttallii*. The riverine community in the background, dominated by *Populus* spp. is at a lower elevation than the sage.

Grassland

Grassland areas are generally located on south and west oriented slopes and on the level plain adjacent to the coulees where cultivation has not occurred. Three major conditions in grassland vegetation exist within the coulees in response to varying moisture regimes.

On the driest sites or on heavily grazed mesic areas, blue grama grass *(Bouteloua gracilis)* is dominant. Where grazing is not severe, *Stipa viridula* is the codominant. Heavily grazed areas are characterized by an increasing abundance of *Opuntia polyacantha, Artemisia frigida,* and *Artemisia ludoviciana* var. *gnaphalodes.* Other associated species include *Selaginella densa, Phlox hoodii, Sphaeralcea coccinea, Erigeron ochroleucus, Lomatium foeniculaceum, Lomatium macrocarpum, Lithospermum incisum,* and *Eriogonum flavum.*

In mesic areas, the most widespread grassland type of the region occurs. This is dominated by the spear grasses, *Stipa spartea* var. *curtiseta* and *Stipa viridula.* Associated grasses include *Stipa comata, Koeleria cristata, Agropyron trachycaulum* var. *unilaterale, Calamagrostis montanensis,* and *Poa interior.* Associated herbaceous species include *Allium textile, Comandra pallida, Anemone patens* var. *wolfgangiana, Potentilla concinna, Astragalus missouriensis, Oxytropis sericea* var. *spicata, Linum lewisii, Viola nuttallii, Gaura coccinea, Selaginella densa, Penstemon nitidus, Campanula rotundifolia, Achillea millefolium* subsp. *lanulosa, Erigeron caespitosus, Gaillardia aristata, Ratibida columnifera, Senecio canus,* and *Solidago missouriensis.*

In the wettest grassland areas, rough fescue *(Festuca scabrella)* becomes dominant. However, in relation to the size of the *Stipa* grassland, the area occupied by the fescue is small. Either a lack of suitable environmental conditions, overgrazing, or competition from aspen, shrubs, or *Stipa* has limited the distribution of fescue grassland to narrow bands or patches. Species commonly found with fescue in the area include *Lilium philadelphicum* var. *andinum, Sisyrinchium montanum, Cerastium arvense, Anemone multifida, Geum triflorum, Hedysarum alpinum* var. *americanum, Hedysarum boreale* var. *cinerascens, Zizia aptera, Galium boreale, Achillea millefolium* subsp. *lanulosa,* and *Agoseris glauca.*

Non-vascular plants common to the grasslands, especially in the drier areas, include: the mosses *Hypnum cupressiforme, Tortella fragilis, Tortula ruralis* and the lichens *Ochrolechia upsaliensis, Dermatocarpon hepaticum* and *Cladonia* spp.

Shrub Vegetation

In depressions or gulleys in grasslands or on north oriented slopes where moisture is not sufficient enough to support tree growth, there is a considerable development of thickets. The dominant shrub species are *Rosa woodsii, Rosa acicularis, Symphoricarpos occidentalis, Amelanchier alnifolia, Elaeagnus commutata, Shepherdia argentea, Prunus virginiana* var. *melanocarpa, Prunus pensylvanica, Ribes oxyacanthoides,* and *Ribes americanum.* These species tend to segregate into two groupings: an *Elaeagnus - Symphoricarpos - Rosa* group, and a *Prunus - Amelanchier - Ribes group.* The taller shrubs grow in the wettest parts of the thickets. *Shepherdia argentea,* although abundant along the river valleys, is less common than the other shrubs.

Herbaceous species common to these thickets include *Lilium philadelphicum* var. *andinum, Smilacina stellata, Arenaria lateriflora, Heracleum lanatum, Vicia americana, Zizia aptera, Monarda fistulosa* var. *menthaefolia,* and *Galium boreale.*

Forested Areas

On north- and east-facing slopes, aspen *(Populus tremuloides)* and spruce *(Picea glauca)* woods predominate with varying degrees of admixture. Although it proved easy to delimit dense spruce stands floristically, difficulties arose in separating mixed woods and pure aspen stands by species composition.

Pure aspen woods tended to have a greater abundance of shrubs *(Prunus* sp., *Rosa* sp., *Symphoricarpos* sp.) than mixed woods. In aspen woods, commonly associated species include *Prunus pensylvanica, P. virginiana* (tall shrubs); *Rosa acicularis, R. woodsii, Shepherdia canadensis, Symphoricarpos albus* var. *pauciflorus, S. occidentalis, Lonicera dioica* var. *glaucescens* (low shrubs); *Smilacina stellata, Arenaria lateriflora, Actaea rubra, Anemone canadensis, Thalictrum venulosum, Fragaria virginiana* var. *glauca, Fragaria vesca* var. *americana, Lathyrus ochroleucus, Viola adunca, Viola rugulosa, Heracleum lanatum, Galium boreale* (herbs).

A large area now covered by aspen woods gives evidence of various stages of spruce regeneration (seedlings, saplings and small spruce). From a number of core samples, it was found that the spruce trees have rapid growth rates. Many trees have an annual diameter increment of up to 0.6 inches and an annual height increase of up to one foot. The largest spruce trees examined were two feet in diameter at breast height and sixty feet tall; however, the average size was 9 inches in diameter and 25 feet in height. The oldest trees examined were sixty-five years of age. (Because of the fire history of the area no older trees were found.) The trees are healthy and during 1971 there was an abundant cone crop.

Mixed woods with a greater abundance of spruce show differences from those with few spruce. Those woods with few spruce are similar floristically to pure aspen woods. With increasing amounts of spruce, species such as *Elymus innovatus, Schizachne purpurascens, Disporum trachycarpum, Smilacina racemosa* var. *amplexicaulis, Anemone cylindrica, Galium triflorum,* and *Aralia nudicaulis* become dominant herbs.

In dense spruce woods, there is a notable absence of the shrub and herb strata (Fig. 10). The white spruce form a continuous canopy underlain by a similarly continuous moss carpet dominated by *Plagiomnium cuspidatum, Abietinella abietina,* and *Hylocomium splendens.* Wintergreens *(Pyrola asarifolia* and *P. secunda)* are commonly found growing in the moss carpet.

Lichens common to the aforementioned wooded areas include: *Alectoria glabra, Evernia mesomorpha, Hypogymnia physodes, Physcia adscendens, Physcia aipolia,* and species of *Cladonia, Parmelia, Peltigera, Usnea* and *Xanthoria.*

Occasionally, aspen and white spruce are found along the major streams, but poplars *(Populus balsamifera* and *P. sargentii)* dominate. Immediately adjacent to the river, the characteristic species are *Juncus balticus* var. *montanus,* and species of *Eleocharis* and *Scirpus.* Separating this semi-aquatic community from the poplar woods is a dense belt of *Salix interior* var. *pedicellata.* In disturbed wooded areas, there is a notable increase of *Urtica gracilis, Solidago gigantea* var. *leiophylla,* and *Hackelia floribunda.*

INTRODUCED PLANTS

An interesting point in relation to the vascular flora of the Drumheller area concerns the large proportion of introduced plants. Some 53 taxons (about 1/6 of the flora) are introduced entities. This is probably due to the great amount of agriculture practised in the area. The commonest introduced weeds are *Agropyron cristatum, Bromus inermis, Hordeum jubatum, Chenopodium album, Thlaspi arvense, Melilotus alba, Melilotus officinalis, Medicago sativa, Lappula echinata, Hyoscyamus niger, Cirsium arvense, Lactuca serriola, Sonchus uliginosus, Taraxacum officinale* and *Tragopogon dubius.*

DISCUSSION OF THE FLORA

The diversity of the vegetation in the Drumheller region would lead one to expect the existence of representatives of plants from many of the vegetation zones of Alberta — the

Coniferous Forest, Aspen Parkland and Grassland areas, for instance. The vascular and non-vascular plants will be analyzed to determine which vegetation zones are best represented in the study area.

An analysis of the data in the papers of Coupland (1950), Clarke, Tisdale and Skoglund (1947) and Smoliak (1965) reveals that both Short-Grass and Mixed Grass vegetation prevail in the Drumheller area. The dominants, as well as most of the secondary species of almost all the faciations of the mixed grassland as described by Coupland, exist in similar situations in the study area. Notably absent, however, are *Carex eleocharis,* which is a principal species in all of Coupland's faciations, and *Muhlenbergia cuspidata,* a species common to the dry eroded slopes elsewhere in the Mixed Grassland zone. Similarly, with respect to the Short-Grass Prairie (Coupland's *Bouteloua-Stipa* faciation and that grassland analyzed by Clarke *et al.*), the same principal and secondary species occur in the Drumheller area, although *Stipa comata* is apparently not as abundant.

An examination of the papers by Moss (1944), Moss and Campbell (1947), Coupland and Brayshaw (1953), and Looman (1969), on the Fescue Grassland, shows that the fescue vegetation of the study area bears a strong resemblance to the so-called "northern prairie" as described by Moss (1932). This is evident by the presence of most of the dominant and secondary species. However, *Helictotrichon hookeri* and *Danthonia intermedia* were not present in the study area, although Moss and Campbell found both in the vicinity. Although dominant in the Fescue Grassland of southwestern Alberta, *Festuca idahoensis, Danthonia parryi, Carex eleocharis, Geranium viscosissimum* and *Potentilla fruticosa* are notably lacking in the fescue grassland of the Drumheller area.

Moss' data in his paper on the poplar association of Alberta (Moss, 1932) make it apparent that our forested areas are closely related to those aspen stands of the parkland of central Alberta. Of the 38 species that were present in more than 50% of Moss' stands, 29 species (76% of

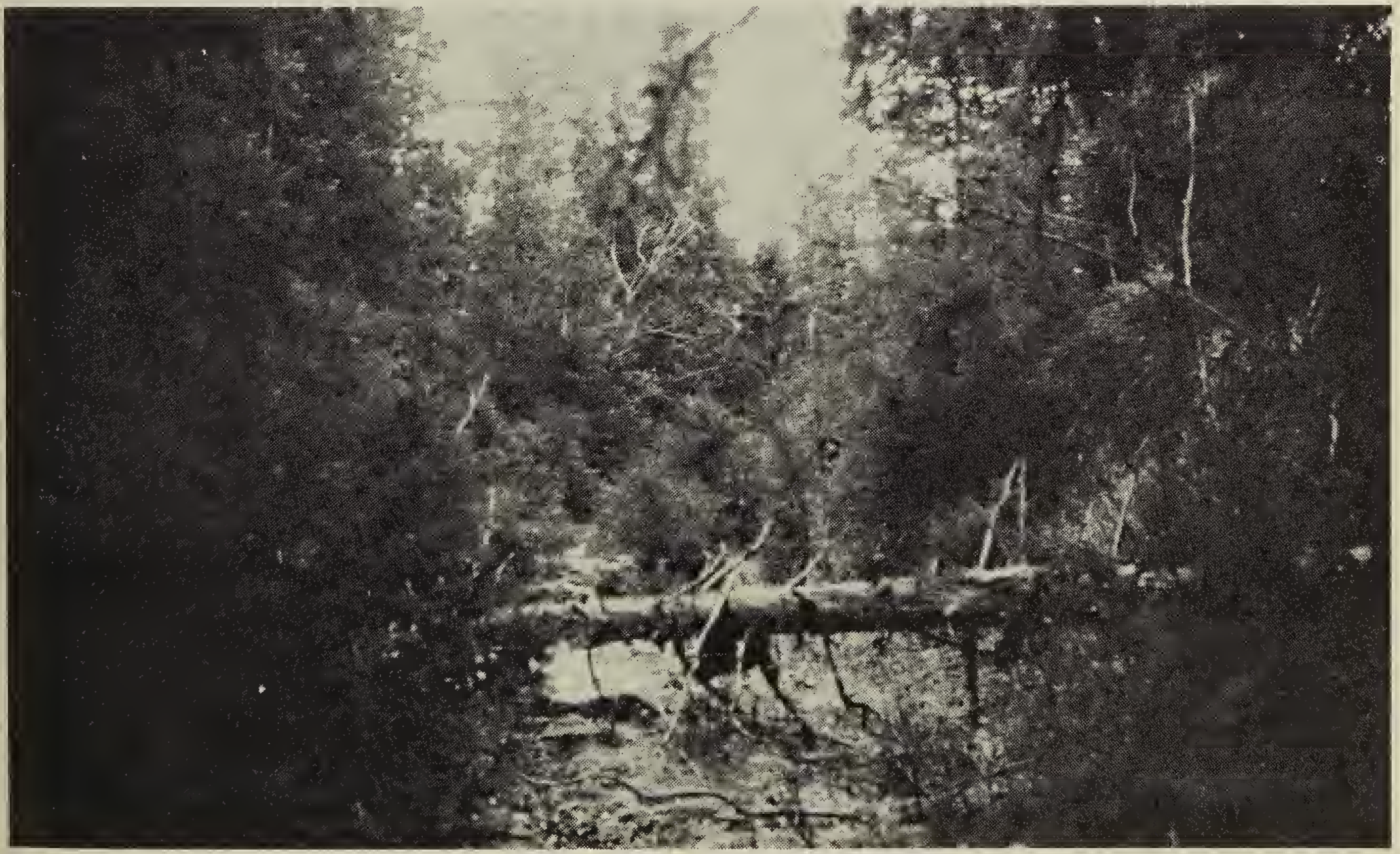


Fig. 10. Dense spruce woods near Beynon. This type of vegetation, although fairly common in the area, has not been recognized or associated with the Drumheller region previously.

Moss' most abundant species) were common throughout the wooded areas of the Drumheller region. Four species which were widespread in Moss' study were found only occasionally in our area. Five species — *Corylus cornuta*, *Bromus ciliatus*, *Mertensia paniculata*, *Cornus canadensis* and *Maianthemum canadense* — were not collected in our study area, but are common to the parkland of central Alberta. Of the 118 species that Moss found in his aspen stands, the study area has 72 (about 60%).

Figure 11 shows a map of spruce distribution along the Red Deer River. Spruce forest is continuous down the Red Deer to the junction of Tail Creek. Downstream from here, however, the spruce woods become more and more restricted, existing only in small pockets on north-facing slopes in the coulees which adjoin the river. The Ghostpine, Kneehills and Rosebud valleys provide an area for the spruce to expand by increasing the area of suitable habitat. The study area is at the southern end of spruce distribution along the Red Deer River and represents the furthest invasion of white spruce into the prairies of Alberta. It is our belief that the distribution of spruce is prevented from going further down the Red Deer by the drier climate and from going up the Rosebud River and Kneehills Creek because the valleys of these rivers become gently sloping and exposed.

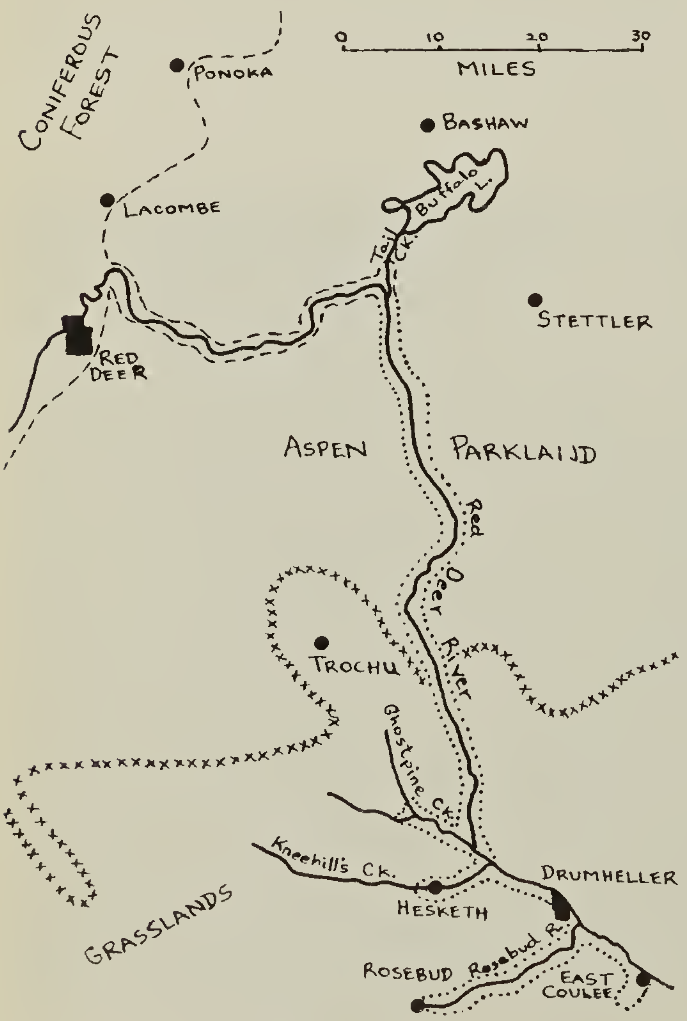


Fig. 11. Discontinuous distribution (dotted line) of coniferous forest along the Red Deer River.

Over 100 vascular plant species present in the study area are common to the cordilleran and boreal forests (MacKenzie-Grieve 1970, La Roi 1967, Moss 1953), but are also found in the aspen parkland. No vascular species found in the study area are restricted to coniferous forests in other parts of the province. A review of the literature dealing with the coniferous vegetation of Alberta makes it apparent that, although there are a large number of vascular species common to both the study area and the coniferous forest, the community structure differs considerably.

Correlated with this diversity in the vascular vegetation is the diversity found in the lichen species. Slightly more than one-half (54 species) of the lichen taxa are restricted to forested areas, with 28 of these restricted to spruce woods in the study area. Of those 28 species, 17 are confined to coniferous forests in Alberta. The species included here are *Alectoria glabra*, *Cetraria pinastri*, *Cladonia chlorophaea*, *Cladonia coniocraea*, *Cladonia deformis*, *Cladonia gracilis* var. *dilatata*, *Cladonia multiformis*, *Hypogymnia tubulosa*, *Letharia vulpina*, *Parmelia flaventior*, *Peltigera canina*, *Peltigera horizontalis*, *Peltigera leucophlebia*, *Peltigera spuria*, *Usnea cavernosa*, *Usnea hirta*, and *Usnea scabrata* subspp. *nylanderiana*. Likewise, certain moss species collected in spruce woods in the Drumheller area are restricted to coniferous forests in Alberta. These, however, are comparatively scarce in the study area, and include the species *Dicranum drummondii*, *Dicranum* *polysetum*, *Dicranum scoparium*, *Oncophorus wahlenbergii*, *Pleurozium schreberi*, *Pohlia nutans* and *Ptilium crista-castrensis*. In regard to the lichens, it is interesting to note that 78% (81 of the 104 species) are circumpolar, and that less than 1/5 are endemic to North America.

ACKNOWLEDGMENTS

Many thanks are due to all of the people who have helped in the preparation of this paper. We are indebted to Dr. C. D. Bird of the University of Calgary, Biology Department, who sponsored the project and aided in the identification and verification of the plant specimens. We gratefully acknowledge Dr. R. T. Ogilvie of the University of Calgary, Biology Department for his help on the ecological aspects of the study. The following persons have also contributed in either identification of specimens or in supplying valuable information: Miss M. Dumais (University of Alberta Herbarium), Mrs. B. Hallworth (University of Calgary Herbarium), Dr. L. Hills (University of Calgary, Geology Department), Mr. A. Marsh (University of Calgary Herbarium) and Dr. N. A. Skoglund (University of Saskatchewan, Saskatoon).

ANNOTATED CATALOGUE OF THE NON-VASCULAR PLANTS

In the following list, 139 species of non-vascular plants are recorded, including 104 lichens, 33 mosses and 2 liverworts. The species are arranged alphabetically. Nomenclature for the lichens follows Hale and Culberson (1970) and for the mosses Crum, Steere and Anderson (1965). All voucher specimens have been deposited in the University of Calgary Herbarium. The numbers, unless prefixed, refer to collections made by the authors. A CDB prefix refers to those collected by Dr. C. D. Bird and a PM prefix refers to Pat MacNeill's collections.

In a few places, there is some taxonomic confusion. *Parmelia infumata* was treated separately, although it is closely related to *Parmelia elegantula*. Because taxonomic difficulties between *Lecanora hageni* and *L. piniperda* have occurred in the past, it is, therefore, not known whether *L. hageni* (PM 640) genuinely occurs here.

Lichens

Acarospora arenacea Magn. Rare, on sandstone outcrop. 884.

Acarospora strigata (Nyl.) Arn. Occasional, on rock. 772, 773.

Acarospora veronensis Mass. Rare, on rock. PM 672.

Agrestia cyphellata Thoms. Occasional, on dry, exposed soil. 752, 774.

Alectoria chalybeiformis (L.) S. Gray. Rare, on rock. PM 825.

Alectoria glabra Mot. Common, mainly on spruce twigs, also on rotting stumps, 793, 797, 870, 880.

Buellia alboatra (Hoffm.) Branth & Rostr. Scarce, on sandstone outcrop. 888.

Buellia triphagmioides Anzi. Scarce, on dead spruce branch. 895.

Caloplaca cerina (Ehrh.) Th. Fr. Occasional, on aspen bark. 890.

Caloplaca flavovirescens (Wulf.) Dalla Torre & Sarnth. Occasional, on sandstone outcrops. 885, 891.

Caloplaca holocarpa (Hoffm.) Wade. Common on aspen bark. 734, 746, 890, 897.

Caloplaca jungermanniae (Vahl.) Th. Fr. Occasional, on soil in dry grassland. 697.

Caloplaca stillicidiorum (Vahl.) Lynge. Rare, on vegetabilia in dry area. PM 648.

Candelaria concolor (Dicks.) B. Stein. Common, mainly on spruce twigs, also on aspen bark and lignum. 731, 795, 855, 873, 894.

Candelariella aurella (Hoffm.) Zahlbr. Common, on sandstone outcrops and soil in dry grassland. 697, 885, 888, 891.

Candelariella vitellina (Ehrh.) Mull. Arg. Occasional, on lignum. 895, 898.

Catillaria glauconigrans (Tuck.) Hasse. Occasional, on aspen bark. 734.

Cetraria pinastri (Scop.) S. Gray. Fairly common, on rotting logs and spruce bark. 849, 850.

Cladonia arbuscula subsp. *beringiana* (Ahti). Rare, on exposed, dry soil. PM 653.

Cladonia cariosa (Ach.) Spreng. Occasional, on exposed dry soil. PM 644, PM 654.

Cladonia chlorophaea (Florke) Spreng. sens. lat. Occasional, on soil in spruce woods. 837, 919.

Cladonia coniocraea (Florke) Spreng. Common, on rotting logs and soil in spruce woods. 714, 726, 727, 796, 829.

Cladonia deformis (L.) Hoffm. Rare on soil in spruce woods. 913.

Cladonia fimbriata (L.) Fr. Common, on rotting logs and on soil in spruce woods. 706, 727, 784, 825, 828.

Cladonia gracilis var. *dilatata* (Hoffm.) Schaer. Occasional, on soil, once on rotting log, in spruce woods. 805, 859, 912.

Cladonia mitis Sandst. Common, on soil in dry grasslands and in spruce woods. 753, 754, 756, 769, 847, 851, 918.

Cladonia multiformis Merr. Occasional, on soil in spruce woods. 848, 858.

Cladonia pityrea (Florke) Fr. Rare, on exposed dry soil. One of only two specimens collected in Alberta, and placed in the University of Calgary Herbarium. CDB 12734.

Cladonia pocillum (Ach.) O. Rich. Common, on soil in dry grassland. 696, 767, 768.

Cladonia pyxidata (L.) Hoffm. Common, on soil in grassland. 701, 703, 872.

Cladonia robbinsii Evans. Occasional, on exposed, dry soil. 766.

Cladonia uncialis (L.) Wigg. Rare, on exposed, dry soil. CDB 12737.

Collema tenax (Sw.) Ach. em Degel. Occasional, on soil in spruce woods. 836.

Cornicularia aculeata (Schreb.) Ach. Occasional, on exposed, dry soil. 764, 765.

Dermatocarpon hepaticum (Ach.) Th. Fr. Fairly common, on soil in dry grassland. 694, 695, 766.

Dimelaena oreina (Ach.) Norm. Rare, on rock. PM 826.

Diploschistes canadensis Ras. Occasional, on exposed, dry soil. PM 638, PM 788, CDB 12730.

Diploschistes scruposus (Schreb.) Norm. Rare, on soil in spruce woods. 907.

Evernia mesomorpha Nyl. Very common, on soil, rotting logs, and spruce bark, in spruce woods. 728, 732, 739, 740, 741, 852, 853, 854, 874.

Fulgensia bracteata (Hoffm.) Ras. Occasional, on soil in grassland. 887.

Fulgensia fulgens (Sw.) Elenk. Occasional, on soil in dry grassland. 694, 695.

Hypogymnia physodes (L.) W. Wats. Fairly common, on rotting logs and spruce twigs in spruce woods. 785, 849, 876, 914.

Hypogymnia tubulosa (Schaer.) Hav. Rare, on twig. PM 667.

Lecanora caesiocinerea Nyl. Rare, on rock. 773.

Lecanora chrysoleuca (Sm.) Ach. Occasional, on rock. 900.

Lecanora cinerea (L.) Somm. Rare, on sandstone outcrop. 905.

Lecanora hageni (Ach.) Ach. Uncertain status, on lignum. This species has been confused with *Lecanora piniperda* in the past. PM 640.

Lecanora melanophthalma (Ran.) Ran. Occasional, on rock and sandstone. 776, 902.

Lecanora muralis (Schreb.) Rabenh. Occasional, on sandstone outcrop. 886.

Lecanora piniperda Korb. Uncertain status, on lignum in spruce woods. See *L. hageni*. 894, 896.

Lecanora rugosella Zahlbr. Rare, on lignum. PM 664.

Lecanora rupicola (L.) Zahlbr. Rare, on sandstone outcrop. 901.

Lecanora variolascens Nyl. (now *L. impudens*). Rare, on spruce bark. 868.

Lecidea decipiens (Ehrh.) Ach. Scarce, on exposed dry soil. PM 633, CDB 25416.

Lecidea glomerulosa (DC. in Lam. & DC.) Steud. Common, on rotting logs, spruce bark, and aspen bark. 806, 840, 869, 897, 898.

Lecidea lithophila (Ach.) Ach. Rare, on rock. 783.

Lecidea stigmatea Ach. Occasional, on rock and sandstone. 778, 779, 906.

Lecidea symmicta (Ach.) Ach. Rare, on lignum in spruce woods. 894, 896.

Lecidea turgidula Fr. Rare, on lignum. This is the only specimen of this species in the University of Calgary Herbarium. CDB 25417.

Lepraria membranacea (Dicks.) Vain. Fairly common, on spruce twigs, soil, and rotting logs in spruce woods. 709, 796, 798.

Letharia vulpina (L.) Hue. Rare, on spruce bark. 860.

Ochrolechia upsaliensis (L.) Mass. Common, on exposed, dry soil. 763, 764, 775, 781.

Parmelia chlorochroa Tuck. Very common, on exposed, dry soil. 704, 748, 764, 770, 771, 780, 781, 782.

Parmelia exasperatula Nyl. Common, on saskatoon twigs, rotting logs, and spruce bark. 733, 807, 808, 873.

Parmelia flaventior Stirt. Common, on rotting logs in spruce woods. 811, 812, 813, 823.

Parmelia infumata Nyl. Rare, on sandstone outcrop. 904.

Parmelia mexicana Gyeln. Occasional, on rock. 757.

Parmelia subdecipiens Vain. Rare, on sandstone outcrop. One of four specimens in the University of Calgary Herbarium. 899.

Parmelia subolivacea Nyl. Fairly common, on spruce twigs, spruce bark and *Betula occidentalis* bark. 794, 795, 839, 877, 898.

Parmelia substygia Ras. Rare, on sandstone outcrop. 903.

Parmelia sulcata Tayl. Very common, on rotting logs and spruce bark in spruce woods, also on aspen bark. 735, 737, 738, 740-742, 788, 805, 812, 815-817, 820, 849.

Parmelia taractica Kremp. Occasional, on rock. 758, 759.

Peltigera canina (L.) Willd. Fairly common, on soil and rotting logs in spruce woods. 726, 800, 857.

Peltigera horizontalis (Huds.) Baumg. Occasional, on soil in spruce woods. 826.

Peltigera lepidophora (Nyl.) Vain. Rare, on exposed, dry soil in grassland. CDB 25418.

Peltigera leucophlebia (Nyl.) Gyeln. Rare, on soil in spruce woods. 911.

Peltigera polydactyla (Neck.) Hoffm. Fairly common, on soil and rotting logs in spruce woods and mixed woods. 711, 726, 743.

Peltigera spuria (Ach.) DC. Rare, on soil on north-facing slope. CDB 25420.

Pertusaria finkii Zahlbr. Scarce, on lignum. PM 640, PM 666.

Physcia adscendens (Th. Fr.) Oliv. Common, on aspen twigs, also on aspen log and saskatoon twigs. 734, 745, 786, 787, 822, 897.

Physcia aipolia (Ehrh.) Hampe. Common, on aspen bark and spruce, also on rotting log. 746, 789, 806, 838, 865.

Physcia caesia (Hoffm.) Hampe. Rare, on sandstone outcrop. 906.

Physcia orbicularis (Neck.) Poetsch. Rare, on spruce bark. 865.

Physcia stellaris (L.) Nyl. Scarce, on lignum. PM 666, CDB 25427.

Physconia grisea (Lam.) Poelt. Occasional, on rotting logs and spruce bark in spruce woods. 823, 864.

Physconia muscigena (Ach.) Poelt. Fairly common, on exposed, dry soil and soil in spruce woods. 761, 844.

Ramalina fastigiata (Pers.) Ach. Occasional, on spruce twigs, spruce bark and aspen bark. 866, 875, 892.

Ramalina pollinaria (Westr.) Ach. Fairly common, on spruce twigs and spruce stump. 867, 879, 893, 908.

Rhizocarpon bolanderi (Tuck) Herre. Rare, on rock. (Thomson, 1967).

Rhizocarpon disporum (Naeg.) Mull. Arg. Occasional, on rock. 759, 762.

Rinodina roscida (Somm.) Arn. Rare, on vegetabilia. PM 648.

Rinodina turfacea (Wahlenb.) Korb. Rare, on dry soil in grassland. 697.

Staurothele fuscocuprea (Nyl.) Zsch. Rare, on sandstone outcrop. 889.

Toninia caeruleonigricans (Lightf.) Th. Fr. Rare, on exposed, dry soil. PM 792.

Usnea cavernosa Tuck. Occasional, on bark and twigs of white spruce. 861, 909.

Usnea compacta Mot. Rare, on aspen bark in mixed woods. 736.

Usnea glabrescens (Nyl. ex Vain.) Vain. Rare, on rotting log in spruce woods. 818, 819.

Usnea hirta (L.) Wigg. Occasional, on spruce twigs and spruce bark in spruce woods. 843, 846, 862.

Usnea scabrata subsp. *nylanderiana* Mot. Fairly common, on bark and twigs of white spruce. 744, 863, 881, 883, 910.

Usnea subfloridana Stirt. Occasional, on bark and twigs of white spruce. 845, 878.

Usnea substerilis Mot. Very common, on bark and twigs of white spruce and on rotting logs in spruce woods. 732, 735, 799, 809, 821, 882, 898.

Xanthoria elegans (Link) Th. Fr. Common, on rock and sandstone outcrops. 698, 702, 886.

Xanthoria fallax (Hepp) Arn. Common on aspen bark in aspen woods, also found on rotting log in spruce woods. 710, 734, 810, 814.

Xanthoria polycarpa (Ehrh.) Oliv. Common, on twigs of white spruce. 789, 790, 791, 792, 795.

Liverworts

Lophocolea heterophylla (Schrad.) Dum. Rare, known from only one collection. CDB 4011.

Marchantia polymorpha L. Occasional, in wet spruce woods. 824, 827, 830, 834, 835.

Mosses

Abietinella abietina (Hedw.) Fleish. Very common, in spruce woods. 711, 712, 715, 717, 719-723, 841, 856.

Amblystegium juratzkanum Schimp. Found in riverine forest. PM 630.

Amblystegium serpens (Hedw.) B. S. G. Occasional, on soil and rotting logs in spruce woods. 726, 834.

Brachythecium salebrosum (Web & Mohr) B. S. G. Common, on soil and rotting logs in aspen and spruce woods. 705, 707, 713, 714, 728, 802-804.

Bryoerythrophyllum recurvirostre (Hedw.) Chen. Scarce, on soil in spruce woods. 712, 715.

Bryum creberrimum Tayl. Reported for the region by Bird (1971) but no specimens seen.

Campylium chrysophyllum (Brid.) J. Lange. Rare, in spruce woods. CDB 3996.

Ceratodon purpureus Brid. Fairly common, on soil in woods and grassland. 711, 730, 750, 802.

Dicranum drummondii C. Mull. Rare, on soil in spruce woods. 917.

Dicranum polysetum Sw. Scarce, but abundant where found, in spruce woods on soil. 915.

Dicranum scoparium Hedw. Rare, on soil in spruce woods. 842.

Drepanocladus uncinatus (Hedw.) Warnst. Occasional, on soil in spruce woods. 711, 712, 719, 841.

Encalypta rhaptocarpa var. *subspathulata* (C. Mull. & Kindb. ex Mac. & Kindb.) CDB 25421.

Eurhynchium pulchellum (Hedw.) Jenn. Fairly common, on rotting logs and soil in spruce and aspen woods. 708, 803, 804, 825, 827, 829, 830, 834, 837.

Fontinalis duriaei Schimp. In the Red Deer River. PM 627, CDB 25407.

Funaria hygrometrica Hedw. Rare, on wet soil in spruce woods. 831.

Grimmia apocarpa Hedw. Rare, on limestone boulder. CDB 3997.

Hygrohypnum luridum (Hedw.) Jenn. In the Red Deer River. CDB 25408.

Hylocomium splendens (Hedw.) B. S. G. Common, on soil in spruce woods. 718, 724, 725, 829, 841.

Hypnum cupressiforme Hedw. Common, on soil in dry grassland. 693, 699-701, 748, 749, 751, 767.

Oncophorus wahlenbergii Brid. Scarce, on rotting wood in forested areas. CDB 4005.

Orthotrichum speciosum var. *elegans* Nees ex Sturm. Rare, on dead willow. CDB 4010.

Plagiomnium cuspidatum (Hedw.) Kopponen. Very common, on soil and rotting logs in wooded areas. 705-707, 711, 715, 729, 804, 824-830, 832-834.

Pleurozium schreberi (Brid.) Mitt. Rare, on rotting logs in spruce woods. CDB 4007.

Pohlia nutans (Hedw.) Lindb. Rare, spruce woods. CDB 4006.

Polytrichum juniperinum Hedw. Scarce, but abundant where found, on soil in spruce woods. 916.

Pseudoleskeela tectorum (Funck ex Brid.) Kindb. ex Broth. Rare, on rotting logs in spruce woods. 801.

Ptilium crista-castrensis (Hedw.) De Not. Rare, on rotting logs in spruce woods. CDB 4007.

Pylaisiella polyantha (Hedw.) Grout. Occasional, on rotting logs in spruce woods. 716, 726, 727.

Rhytidium rugosum (Hedw.) Kindb. Occasional, on soil in dry grassland. 701, 747, 755.

Tortella fragilis (Hook. ex Drumm.) Limpr. Occasional, on soil in dry grassland. 692, 701.

Tortula mucronifolia Schwaegr. Occasional, on soil and rotting logs in spruce woods. 802, 803, 824, 825.

Tortula ruralis (Hedw.) Gaertn., Meyer & Scherb. Common, on soil in dry grasslands and occasionally on soil in spruce woods. 692, 749, 871.

ANNOTATED CATALOGUE OF THE VASCULAR PLANTS

In this catalogue, the various families of vascular plants are listed in the botanical order followed by Moss (1959). The genera and species, however, are listed in alphabetical order. The numbers following the listings refer to the authors' collection numbers or where noted, to the few collections made by others. These other collections have been included to make the list as complete as possible. Our specimens are deposited in the University of Calgary Herbarium. Nomenclature for the vascular plants is according to Moss (1959), unless otherwise noted.

The catalogue contains species from 53 families and includes some 315 specific or subspecific entities. The bulk of the species is contained within a comparatively small number of families, the three largest as follows: Compositae (59), Gramineae (42), Leguminosae (29).

POLYPODIACEAE

Cystopteris fragilis (L.) Bernh. (*Filix fragilis* (L.) Gilib.) Fairly common in forested areas and wet thickets. 73, 141, 345, 504.

Woodsia oregana D. C. Eat. Rare, known from only one collection. Moss 7075 (University of Alberta Herbarium, Edmonton).

EQUISETACEAE

Equisetum arvense L. Occasional along creeks in spruce woods. 609, 612.

Equisetum laevigatum A. Br. Fairly common along railways and moist disturbed areas. 552.

Equisetum variegatum Schleich. Reported for the region by Bird (1971) but no specimens seen.

SELAGINELLACEAE

Selaginella densa Rydb. Very common and abundant, a characteristic species of the dry grassland. 375.

PINACEAE

Juniperus communis L. var. *depressa* Pursh. Fairly common in moist depressions in grassland and adjacent forested areas. 75, 567.

Juniperus horizontalis Moench. Common on dry exposed hillsides. 591.

Picea glauca (Moench) Voss. Very common and abundant on north-oriented slopes and occasionally in valley bottoms. 277.

TYPHACEAE

Typha latifolia L. Abundant where found, but restricted somewhat due to the absence of ponds within the coulee systems. 679.

GRAMINEAE

Agropyron cristatum (L.) Gaertn. Common in disturbed grassland areas. 200, 228, 296, 318, 555.

Agropyron dasystachyum (Hook.) Scribn. Fairly common on dry open hillsides. 688.

Agropyron repens (L.) Beauv. Fairly common on damp disturbed areas and along roads and creeks. 234, 384, 458. 1.

Agropyron smithii Rydb. var. *molle* (Scribn. & Smith) Jones. 689.

Agropyron spicatum (Pursh) Scribn. & Smith var. *inerme.* Occasional in dry grasslands. 422.

Agropyron trachycaulum (Link) Malte var. *unilaterale.* Common in grasslands and open woods. 421, 455.

Agropyron trachycaulum (Link) Malte (*A. pauciflorum* (Schwein.) Hitchc.) Occasional in moist disturbed areas and grassland. 377, 457. 1, 544.

Avena fatua L. Scarce, as an introduced weed. 523.

Beckmannia syzigachne (Steud.) Fern. Fairly common in wet places. 615.

Bouteloua gracilis (HBK.) Lag. Common on dry south-oriented slopes. 371.

Bromus inermis Leyss. Very common and abundant, especially in disturbed habitats. Introduced. 235, 524, 551, 672.

Calamagrostis canadensis (Michx.) Beauv. Common in wet areas, especially along creeks. 616.

Calamagrostis inexpansa A. Gray. Scarce, in damp places. 675.

Calamagrostis montanensis Scribn. Fairly common in dry grassland. 300, 460.

Calamovilfa longifolia (Hook.) Scribn. Scarce, on dry open slopes. 670.

Deschampsia caespitosa (L.) Beauv. Occasional in wet meadows and along creeks. 327.

Elymus canadensis L. Common and often abundant along creeks. 684.

Elymus innovatus Beal. Occasional but sometimes abundant in spruce woods. 225, 671.

Elymus macounii Vasey (= *Agropyron trachycaulum* × *Hordeum jubatum*). 549.

Festuca scabrella Torr. Fairly common, the dominant species of moist grasslands. 423, 578.

Glyceria grandis S. Wats. Occasional in shallow water. 569.

Hordeum jubatum L. Common and often abundant as an introduced roadside weed. 376, 545, 673.

Hordeum jubatum L. var. *caespitosum* (Scribn.) Hitchc. Scarce in disturbed areas. 404.

Hordeum vulgare L. Rare, as an escape from cultivation. 508.

Koeleria cristata (L.) Pers. (*K. gracilis* Pers.) Frequent in dry grassland. 269, 398, 419.

Muhlenbergia richardsonis (Trin.) Rydb. Fairly common in moist grasslands. 456, 522.

Phleum pratense L. Occasional beside creeks, introduced. 683.

Poa canbyi (Scribn.) Piper. 226.

Poa compressa L. 85.

Poa cusickii Vasey. 233, 266.

Poa interior Rydb. Common in dry grassland. 227, 399, 424.

Poa palustris L. Fairly common in aspen woods and thickets. 323, 550.

Poa secunda Presl (*P. sandbergii* Vasey). 380.

Puccinellia nuttalliana (Schult.) Hitchc. (*P. airoides* (Nutt.) Wats. & Coult.) Occasional in moist grassland areas. 457.

Schizachne purpurascens (Torr.) Swallen. Occasional in woodlands and thickets. 686.

Secale cereale L. Rare, as an escape from cultivation. 87, 230.

Setaria viridis (L.) Beauv. Rare, at the edge of a cultivated field. 664.

Spartina gracilis Trin. Common along creeks. 295.

Stipa columbiana Macoun var. *nelsonii* (Scribn.) Hitchc. Rare, in moist grassland. 540.

Stipa comata Trin. & Rupr. Fairly common on dry grassland. 425.

Stipa spartea Trin. var. *curtiseta* Hitchc. Very common, a principal grassland species. 420, 453.

Stipa viridula Trin. Very common, also a principal grassland species. 288, 417, 454, 492.

CYPERACEAE

Carex aquatilis Wahlenb. Common along rivers and creeks. 99.

Carex atherodes Spreng. Scarce, but abundant where found, along creeks. 921.

Carex filifolia Nutt. Occasional on dry exposed grassy slopes. 86.

Carex cfr. *lasiocarpa* Ehrh. var. *lati-*

folia (Bock) Gleason (*C. lanuginosa* Michx.) 94.

Carex sprengelii Dewey. Occasional in aspen woods. 124, 324.

Eleocharis acicularis (L.) R. & S. Rare, at the bottom of dry ponds. 561.

Eleocharis palustris (L.) R. & S. Occasional along rivers. 98.

Scirpus acutus Muhl. Occasional along rivers, creeks and ponds. 382.

Scirpus americanus Pers. Occasional along rivers, creeks and ponds. 97.

Scirpus microcarpus Presl. Occasional in wet places. 444, 613.

Scirpus validus Vahl. Common along rivers, creeks and ponds. 83, 100, 381, 445, 487.

LEMNACEAE

Lemna minor L. Rare, on stagnant pool. 203.

JUNCACEAE

Juncus balticus Willd. var. *montanus* Engelm. Very common and abundant along creeks and rivers and in other wet places. 95, 102, 491, 674.

Juncus bufonius L. Rare, in old creek bed. 590.

LILIACEAE

Allium textile Nels. & Macbr. Very common in dry grasslands. 42, 65.

Asparagus officinalis L. (Bailey, 1964). Rare, in poplar woods. Introduced. 389, 418.

Disporum trachycarpum (S. Wats.) B. & H. Common in aspen woods. 28, 56, 140.

Lilium philadelphicum L. var. *andinum* (Nutt.) Ker. Fairly common in moist grasslands and thickets. 282, 365.

Smilacina racemosa (L.) Desf. var. *amplexicaulis* (Nutt.) S. Wats. Frequent in aspen woods. 171.

Smilacina stellata (L.) Desf. Very common in aspen woods and thickets. 43, 66, 122, 136, 183.

IRIDACEAE

Sisyrinchium montanum Greene. Fairly common in moist grasslands. 127, 128, 207, 209.

SALICACEAE

Populus balsamifera L. Very common along the major streams. 262, 565.

Populus sargentii Dode (*P. deltoides* Marsh var. *occidentalis* Rydb.) Common along major streams. 261, 576.

Populus tremuloides Michx. Very common and abundant throughout the coulees and river valleys. 620.

T. C. Brayshaw (1965) provides further insight into the hybrid poplars which frequently occur in this region. Using his index, we have found a 4/8 cross between *P. balsamifera* and *P. trichocarpa* (no. 116). Brayshaw found trispecific hybrids of *P. balsamifera, P. sargentii* and *P. tremuloides* as well as hybrids between *P. sargentii* and *P. tremuloides.*

Salix bebbiana Sarg. Common along creeks in coulees and river valleys. 23, 25, 37, 117.

Salix interior Rowlee var. *pedicellata* (Anderss.) Ball. Common and abundant along river valleys. 118, 586.

Salix lutea Nutt. Fairly common along streams. 63, 96, 587.

BETULACEAE

Betula occidentalis Hook. (*B. fontinalis* Sarg.) Common in wooded areas especially near streams. 39.

URTICACEAE

Urtica gracilis Ait. Fairly common in disturbed habitat in forested areas, especially aspen woods. 414.

SANTALACEAE

Comandra pallida A. DC. Fairly common in grasslands. 78, 115, 343.

POLYGONACEAE

Eriogonum flavum Nutt. Common on dry exposed sites. 129, 177, 272, 392.

Polygonum coccineum Muhl. Common and abundant in sloughs on land adjacent coulees. 490.

Polygonum convolvulus L. Rare in wet disturbed area along creek, introduced weed. 600.

Polygonum lapathifolium L. Scarce, along creeks. 588.

Rheum rhaponticum L. (Bailey, 1964). Rare, at edge of railway, escape from cultivation. 257.

Rumex mexicanus Meisn. Frequent in wet places. 268, 359, 446, 634.

Rumex occidentalis S. Wats. var. *fenestratus* (Greene) LePage. Occasional in wet places. 685.

CHENOPODIACEAE

Atriplex hortensis L. Occasional as an introduced weed of waste places. 577, 629, 676.

Atriplex nuttallii S. Wats. Common in sageland. 273, 391, 515.

Axyris amaranthoides L. Rare, in overgrazed spruce forest, introduced. 564.

Chenopodium album L. Fairly common as an introduced weed of disturbed areas. 427, 475, 480, 506.

Chenopodium capitatum (L.) Aschers. Rare, in spruce woods. 656.

Chenopodium cfr. *fremontii* S. Wats. 563.

Chenopodium hybridum L. var. *gigantospermum* (Aellen) Rouleau. Scarce, in moist areas. 654, 680.

Eurotia lanata (Pursh) Moq. Common in sageland. 199, 213, 461.

Salsola kali L. var. *tenuifolia* Tausch. Occasional as an introduced weed of dry disturbed areas. 554.

Sarcobatus vermiculatus (Hook) Torr. C. D. Bird 12743 (University of Calgary Herbarium).

AMARANTHACEAE

Amaranthus graecizans L. Occasional as an introduced weed of roadsides. 678.

Amaranthus retroflexus L. Occasional as an introduced weed of roadsides. 677.

NYCTAGINACEAE

Mirabilis hirsuta (Pursh) MacM. Scarce in moist depressions in grassland. 458, E. H. Moss 7072 (University of Alberta Herbarium, Edmonton).

CARYOPHYLLACEAE

Arenaria lateriflora L. Common in thickets and aspen woods. 153, 164, 252, 582.

Cerastium arvense L. Common in moist grasslands and thickets. 58, 77, 89, 154, 344.

RANUNCULACEAE

Actaea rubra (Ait.) Willd. Frequent in aspen woods. 139, 214, 250, 483.

Actaea rubra (Ait.) Willd. forma *neglecta* (Gillman) Robins. This form was observed once. A specimen was collected, but the fruits became detached and lost before they could be preserved.

Anemone canadensis L. Common in woods adjacent streams. 142, 222, 249, 388, 493.

Anemone cylindrica A. Gray. Fairly common in moist grasslands and forests. 340, 605, 607, 636.

Anemone multifida Poir. var. *hudsoniana* DC. Occasional in moist grassland. 246, 294.

Anemone patens L. var. *wolfgangiana* (Bess.) Koch. Common in dry grasslands. 1, 4.

Aquilegia brevistyla Hook. Occasional in forested areas. 165, 293.

Clematis verticellaris DC. var. *columbiana (Nutt)* A. Gray. Frequent in aspen woods. 22, 472.

Ranunculus abortivus L. Rare in damp spruce woods. 210.

Ranunculus acris L. Rare, clearing in spruce woods. Introduced. 329.

Ranunculus cymbalaria Pursh. Common in wet areas. 93, 103, 172, 668.

Ranunculus macounii Britt. Occasional along creeks. 306, 653.

Ranunculus rhomboideus Goldie. Occasional in grasslands. 920.

Ranunculus sceleratus L. Occasional at the margin of ponds. 326, 571.

Thalictrum venulosum Trel. Common in aspen woods. 137, 248.

FUMARIACEAE

Corydalis aurea Willd. Occasional in aspen woods. 107, 166, 205, 666.

CAPPARIDACEAE

Cleome serrulata Pursh. Rare, disturbed roadside. 548.

CRUCIFERAE

Arabis hirsuta (L.) Scop. var. *glabrata* T. & G. Occasional in moist grassland. 151, 156, 168, 298.

Arabis holboellii Hornem. var. *retrofracta* (Graham) Rydb. A scarce plant of dry exposed hillsides. 44.

Armoracia rusticana Gaertn. Rare, as an escape from cultivation. 258.

Brassica hirta Moench. Rare, on disturbed ground. 530.

Brassica juncea (L.) Cosson. Rare, on disturbed ground. 459.

Brassica kaber (DC.) L. C. Wheeler var. *pinnatifida* (Stokes) Wh. (*Sinapis arvensis* L.) Occasional as an introduced weed. 190, 663.

Capsella bursa-pastoris (L.) Medic. Weed of moist disturbed areas, scarce. 682.

Descurainia pinnata (Walt.) Britt. Scarce in dry disturbed areas. 202, 264.

Descurainia richardsonii (Sweet) O. E. Schulz. Occasional in damp forested areas. 413, 655.

Erysimum cheiranthoides L. Rare, in aspen woods. 410.

Erysimum inconspicuum (S. Wats.) MacM. Fairly common in open grasslands. 74, 92, 150, 158, 184.

Hesperis matronalis L. Rare, at the edge of a thicket, garden escape. 197, 259.

Lesquerella arenosa (Richards.) Rydb. Fairly common in dry grasslands. 49, 70, 149.

Rorippa islandica (Oeder) Borbas S. Luyken 24 (University of Calgary Herbarium).

Rorippa islandica (Oeder) Borbas var. *hispida* (Desv.) Butters & Abbe. Rare, in abandoned field. 111.

Sisymbrium altissimum L. Rare, as an introduced weed, in roadside ditch. 379.

Sisymbrium loeselii L. Fairly common as an introduced weed of waste places. 84, 123, 240.

Thlaspi arvense L. Common introduced weed of disturbed areas. 11, 109, 181, 265, 283.

SAXIFRAGACEAE

Heuchera richardsonii R. Br. Fairly common in moist grasslands. 347.

Ribes americanum Mill. Fairly common in thickets and aspen woods. 159.

Ribes oxyacanthoides L. Common in thickets and aspen woods. 36, 566.

ROSACEAE

Amelanchier alnifolia Nutt. Very common on hillsides where it forms thickets and in aspen woods. 20, 34.

Crataegus chrysocarpa Ashe. Scarce, at the edge of aspen woods. 593.

Fragaria vesca L. var. *americana* Porter (*F. americana* (Porter) Britt.) Occasional in mixed woods. 468, 649.

Fragaria virginiana Duchesne var. *glauca* S. Wats. (*F. glauca* (S. Wats.) Rydb.) Very common in wooded areas. 19, 82, 138, 167, 216, 409.

Geum allepicum Jacq. var. *strictum* (Ait.) Fern. Occasional in open woods. 621, 640.

Geum triflorum Pursh. Frequent in moist grasslands. 24, 147.

Potentilla anserina L. Common in wet areas. 104, 143, 212, 572.

Potentilla arguta Pursh. Occasional in moist grasslands and thickets. 285, 353.

Potentilla concinna Richards. Common in dry grasslands. 30, 52, 68, 80, 152.

Potentilla gracilis Dougl. var. *pulcherrima* (Lehm.) Fern. Rare, moist grasslands. 352.

Potentilla norvegica L. Scarce, in damp wooded areas. 617, 637.

Potentilla pensylvanica L. 28, 368.

Potentilla pensylvanica L. var. *bipinnatifida* (Dougl.) T. & G. Both the variety and the species are fairly common in dry grasslands. 260, 331.

Prunus pensylvanica L. f. Occasional in aspen woods and thickets. 27, 498.

Prunus virginiana L. var. *melanocarpa* (A. Nels.) Sarg. Very common in thickets and open woods. 64, 81.

Rosa acicularis Lindl. Common in aspen woods and thickets. 106, 242.

Rosa arkansana Porter. Scarce, in dry exposed grasslands. 309.

Rosa woodsii Lindl. Very common in aspen woods and thickets. 174, 224, 241, 434.

Rubus strigosus Michx. Occasional, sometimes abundant, in mixed woods. 626, 650.

LEGUMINOSAE

Astragalus aboriginum Richards. Rare, at the edge of roadside thicket. 239.

Astragalus adsurgens var. *robustior* Hook. (*A. striatus* Nutt.) Fairly common in moist grasslands. 281, 337, 447.

Astragalus agrestis Dougl. Grasslands and disturbed areas, occasional. 120, 157, 188.

Astragalus bisulcatus (Hook.) A. Gray. Fairly common in grasslands. 114, 121, 307.

Astragalus canadensis L. C. Pilling 48. (University of Calgary Herbarium).

Astragalus drummondii Dougl. Occasional in dry grassland. 180, 194.

Astragalus flexuosus Dougl. E. H. Moss 7064. (University of Alberta Herbarium, Edmonton).

Astragalus gilviflorus Sheld. (*A. triphyllus* Pursh). Occasional in dry south-facing areas. 54.

Astragalus missouriensis Nutt. Fairly common in dry grassland. 17, 57, 311.

Astragalus tenellus Pursh. Fairly common in dry grasslands and disturbed areas. 193, 208, 312, 339, 499.

Caragana arborescens Lam. Scarce, as a garden escape. 110.

Glycyrrhiza lepidota (Nutt.) Pursh. Fairly common at the edge of thickets. 209, 371.

Hedysarum alpinum L. var. *americanum* Michx. Fairly common in moist grasslands. 245, 279, 346, 355, 501.

Hedysarum boreale Nutt. var. *cinerascens* (Rydb.) Rollins. Fairly common in grasslands. 254, 308, 408.

Lathyrus ochroleucus Hook. Very common in aspen woods. 160, 206, 244, 251, 321.

Medicago lupulina L. Rare, introduced weed, overgrazed wet area. 330.

Medicago sativa L. Common as an introduced weed in roadside ditches. 169, 204, 291, 462.

Melilotus alba Desr. Occasional in roadside ditches, introduced weed. 451, 525.

Melilotus officinalis (L.) Lam. Common in roadside ditches, introduced weed. 191, 393, 450.

Oxytropis campestris (L.) DC. var. *gracilis* (A. Nels.) Barneby. Fairly common in grasslands. 334, 356, 407.

Oxytropis sericea Nutt. var. *spicata* (Hook.) Barneby. Fairly common in dry grasslands. 16, 40, 255.

Petalostemon candidum (Willd.) Michx. Occasional in dry grassland. 405.

Petalostemon purpureum (Vent.) Rydb. Fairly common in grasslands. 304, 314, 363, 406, 436, 459. 1.

Psoralea esculenta Pursh. Rare, on dry south-facing slope. 130.

Thermopsis rhombifolia (Nutt.) Richards. Common in grasslands and disturbed areas. 9, 13, 21, 596.

Trifolium repens L. Occasional as an introduced weed of roadsides. 211.

Vicia americana Muhl. Very common in thickets and open woods. 148, 175, 236, 502.

Vicia americana Muhl. var. *truncata* (Nutt.) Brewer. Occasional in thickets and open woods. 511.

Vicia sparsifolia Nutt. Occasional in grasslands. 71, 76, 187.

LINACEAE

Linum lewisii Pursh. Fairly common on dry slopes. 144.

Linum rigidum Pursh. Occasional in dry grasslands. 223, 315.

Linum usitatissimum L. Rare, an escape from cultivation. In waste places. 529.

ACERACEAE

Acer negundo L. var. *interius* (Britt.) Sarg. Scarce, along streams. An introduced garden escape. 387.

MALVACEAE

Malva rotundifolia L. H. F. Irwin (no number) (University of Alberta Herbarium, Edmonton).

Sphaeralcea coccinea (Pursh) Rydb. Fairly common in dry grasslands. 134, 313, 400.

VIOLACEAE

Viola adunca J. E. Smith. Common in aspen woods. 15, 45, 125, 432, 647.

Viola nuttallii Pursh. Fairly common in grasslands. 7, 12, 47, 46.

Viola rugulosa Greene. Common in aspen woods. 60, 126, 170, 469.

CACTACEAE

Opuntia fragilis (Nutt.) Haw. Occasional, sometimes forming large patches in *Stipa* grassland. 416.

Opuntia polyacantha Haw. Very common on overgrazed and sparse exposed grasslands. 196, 263.

ELAEAGNACEAE

Elaeagnus commutata Bernh. Very common, forming thickets on slopes and in valleys. 113, 162.

Shepherdia argentea Nutt. Fairly common in river valleys and occasionally on moist slopes. 26, 62.

Shepherdia canadensis (L.) Nutt. Occasional in spruce and aspen woods. 164, 215.

ONAGRACEAE

Epilobium angustifolium L. Occasional at the edge of woods and on disturbed ground. 267, 411, 536.

Epilobium glandulosum Lehm. Scarce but abundant where found, along creeks in wooded areas. 622, 628, 638, 643.

Gaura coccinea Pursh. Common in grasslands. 131, 192, 237, 256, 386, 390.

Gaura coccinea Pursh var. *glabra* (Lehm.) Torr. & Gray. Rare, dry grassland. 132.

Oenothera biennis L. var. *hirsutissima* Gray. Rare, at the edge of thicket. 452, 542.

ARALIACEAE

Aralia nudicaulis L. Common and often abundant in wooded areas. 163, 439, 610, 646.

UMBELLIFERAE

Cicuta douglasii (DC.) Coult. & Rose. Scarce, in creek bottom in spruce woods. 604, 625.

Heracleum lanatum Michx. Fairly common in wet thickets and along creeks in forested areas. 286, 662.

Lomatium foeniculaceum (Nutt.) Coult. & Rose. Common in dry grassland. 2, 6, 10, 53.

Lomatium macrocarpum (Hook. & Arn.) Coult. & Rose. Fairly common in eroded grassland areas. 32, 50, 189.

Musineon divaricatum (Pursh) Nutt. var. *hookeri* T. & G. Occasional in dry grassland. 31, 41, 51, 91.

Sanicula marilandica L. Rare in spruce woods. 639.

Zizia aptera (A. Gray) Fern. (*Z. cordata* (Walt.) Koch.) Common in thickets and aspen woods. 79, 135.

CORNACEAE

Cornus stolonifera Michx. Common in *Populus* woods. 72.

PYROLACEAE

Pyrola asarifolia Michx. Common in the mossy carpet of dense spruce woods. 641, 648, 667.

Pyrola secunda L. Common in the mossy carpet of dense spruce woods. 471, 642.

ERICACEAE

Arctostaphylos uva-ursi (L.) Spreng. Common in moist thickets and edges of woods on north-oriented slopes. 33.

PRIMULACEAE

Androsace occidentalis Pursh. Marion E. Moodie 831 (Harvard University-Gray Herbarium).

Androsace septentrionalis L. Occasional in exposed grasslands. 195, 229.

Dodecatheon radicatum Greene. Rare, in dry grassland. 8.

Lysimachia ciliata.. L. Scarce, but sometimes abundant, along creeks in woods. 594.

APOCYNACEAE

Apocynum cannabinum L. S. S. Stephens (no number) (University of Alberta Herbarium, Edmonton).

CONVOLVULACEAE

Convolvulus sepium L. Occasional in open wet areas and locally abundant along roadsides on land adjacent the coulee systems. 299, 305.

POLEMONIACEAE

Collomia linearis Nutt. Rare, in dry grassland. 284, 287.

Phlox hoodii Richards. Very common in eroded grassy areas. 3, 5, 29, 55.

BORAGINACEAE

Echium vulgare L. Rare, adjacent railway. 597.

Hackelia americana (A. Gray) Fern. Scarce, in forested areas. 320, 644.

Hackelia floribunda (Lehm.) I. M. Johnston. Fairly common in aspen woods. 320. 1, 470, 482, 535.

Lappula echinata Gilib. Fairly common in disturbed areas. 108, 201, 507, 631.

Lappula redowskii (Hornem.) Greene var. *occidentalis* (Wats.) Rydb. Rare, in overgrazed dry grassland. 182.

Lithospermum incisum Lehm. Occasional in dry grassland. 48, 69, 88.

LABIATAE

Lycopus asper Greene. Rare, at the edge of a pond. 443.

Mentha arvensis L. var. *villosa* (Benth.) S. R. Stewart. Occasional in wet areas. 442, 611, 645.

Moldavica parviflora (Nutt.) Britt. Occasional at edges of cultivated fields. 690.

Monarda fistulosa L. var. *menthaefolia* (Graham) Fern. Common in thickets and moist grassland. 328, 357.

Prunella vulgaris L. Rare, at the edge of a pond. 338.

Stachys palustris L. var. *pilosa* (Nutt.) Fern. Rare, in creek bottom. 691.

SOLANACEAE

Hyoscyamus niger L. Fairly common and often abundant in disturbed land. 90, 238.

SCROPHULARIACEAE

Orthocarpus luteus Nutt. Scarce in grasslands. 517.

Penstemon gracilis Nutt. Scarce in dry grassland. 276, 317.

Penstemon nitidus Dougl. Frequent in dry grassland. 14, 35.

OROBANCHACEAE

Orobanche fasciculata Nutt. A. L. Bird 216 (University of Calgary Herbarium).

PLANTAGINACEAE

Plantago eriopoda Torr. J. H. Brodie (no number) (University of Alberta Herbarium, Edmonton).

Plantago major L. Common in wet areas along streams. 383, 570, 589.

RUBIACEAE

Galium boreale L. Very common in moist grasslands, thickets and aspen woods. 155, 180, 221, 243, 253, 448, 500.

Galium triflorum Michx. Occasional in aspen and mixed woods. 412.

CAPRIFOLIACEAE

Linnaea borealis L. var. *americana* (Forbes) Rehd. Occasional, but abundant where found, in spruce woods. 599.

Lonicera dioica L. var. *glaucescens* (Rydb.) Butters. Common in aspen woods. 173, 247.

Lonicera tartarica L. Reported for region (Bird, 1971) but no specimens seen. An introduced garden escape.

Symphoricarpos albus (L.) Blake var. *pauciflorus* Robbins. Fairly common in aspen and mixed woods. 562, 595, 598, 651.

Symphoricarpos occidentalis Hook. Very common, forming thickets on hillsides. 322, 333, 349, 574, 602.

Viburnum edule (Michx.) Raf. Occasional in mixed woods. 530, 657.

CAMPANULACEAE

Campanula rotundifolia L. Common in grasslands. 278, 290, 360.

COMPOSITAE

Achillea millefolium L. subsp. *lanulosa* (Nutt.) Piper. Very common in grassland. 67, 185, 601.

Achillea millefolium L. subsp. *lanulosa* (Nutt.) Piper var. *alpicol* (Rydb.) Garrett. 157.

Achillea sibirica Ledeb. Scarce, but sometimes abundant, along creeks in woods. 494.

Agoseris glauca (Pursh) Raf. var. *agrestis* (Osterh.) Q. Jones. Fairly common on the edge of thickets and moist grassland. 335, 351, 373.

Agoseris glauca (Pursh) Raf. var. *glauca*. Rare, in grassland. 303.

Antennaria nitida Greene. Fairly common in moist grassland. 218, 332.

Antennaria parviflora Nutt. Scarce in grasslands. 179.

Antennaria rosea Greene. Fairly common in moist grassland. 217.

Arnica fulgens Pursh. Scarce, in dr grassland. 219.

Arnica sororia Greene. Rare, in dr grassland. 289.

Artemisia absinthium L. Scarce, i waste places. 556, 630.

Artemisia biennis Willd. Occasiona along creeks on bare ground. 635.

Artemisia campestris L. subsp *campestris*. Occasional in disturbe areas adjacent creeks. 539, 614.

Artemisia cana Pursh. Very commo forming sage communities on bar flats and hillsides. 573.

Artemisia dracunculus L. Rare, in riverine community. 575.

Artemisia frigida Willd. Common in grasslands, increasing with grazing. 465, 516.

Artemisia longifolia Nutt. Common in sageland. 270, 275, 429, 464, 581, 608.

Artemisia ludoviciana Nutt. var. *gnaphalodes* (Nutt.) T. & G. Common in grasslands and increasing with grazing. 476, 531, 652, 660.

Aster brachyactis Blake. Rare, in wet creek bottom in spruce woods. 623.

Aster campestris Nutt. Reported for the region (Bird, 1971) but no specimens seen.

Aster canescens Pursh. Dry eroded areas and sagelands, common. 435, 518, 632, 665.

Aster ciliolatus Lindl. Scarce, in moist woods. 580, 606.

Aster falcatus Lindl. Common in dry grasslands. 438, 479, 482, 485, 520, 579.

Aster hesperius A. Gray. Fairly common in wet woods. 584, 619, 629, 669.

Aster laevis L. var. *geyeri* A. Gray. Common in disturbed moist habitats. 474, 481, 526, 538.

Aster pansus (Blake) Cronq. Common in disturbed areas and woodlands. 512, 533, 585, 618.

Chrysopsis villosa (Pursh) Nutt. var. *villosa* Cronq. Common in dry eroded areas. 534, 539, 547, 568.

Cirsium arvense (L.) Scop. Occasional in waste places, introduced. 514.

Cirsium undulatum (Nutt.) Spreng. Occasional in dry exposed sites. 341.

Crepis tectorum L. Scarce, an introduced weed of disturbed areas. 178, 319.

Erigeron caespitosus Nutt. Common in dry grasslands. 302, 325, 342, 348, 364, 369, 372, 402, 431, 433, 440, 466, 473, 484, 489, 503, 519, 527.

Erigeron glabellus Nutt. subsp. *pubescens* (Hook.) Cronq. Occasional in moist grasslands and woods. 488, 528, 583, 681.

Erigeron ochroleucus Nutt. Fairly common in dry sageland. 198, 271, 367, 370, 495.

Gaillardia aristata Pursh. Common in dry grassland. 231, 292, 336, 354, 394, 426.

Grindelia squarrosa (Pursh) Dunal var. *quasiperennis* Lunell. Common in dry sageland. 350, 403, 437, 543.

Gutierrezia sarothrae (Pursh) Britt. & Rusby. Common in dry sageland. 430, 521, 553.

Haplopappus spinulosus (Pursh) DC. Scarce, on arid sites. 366.

Helenium autumnale L. var. *montanum* (Nutt.) Fern. Rare, edge of pond. 441, 486.

Helianthus annuus L. subsp. *lenticularis* (Dougl.) Cockerell. Fairly common in dry grassland. 316, 358, 396, 496, 537.

Helianthus laetiflorus Pers. var. *subrhomboideus* (Rydb.) Fern. Occasional in dry grassland. 497.

Helianthus petiolaris Nutt. Occasional in grasslands. 467, 546.

Hieracium umbellatum L. Scarce, in creek bottoms. 477, 659.

Hymenoxys richardsonii (Hook.) Cockerell. Common in dry grasslands. 105, 176, 220, 401.

Lactuca pulchella (Pursh) DC. Occasional in grasslands and moist places. 385, 415, 541, 557.

Lactuca serriola L. Fairly common on disturbed ground, introduced. 505, 603, 627.

Liatris punctata Hook. Rare, on dry eroded slope. 449.

Lygodesmia juncea (Pursh) D. Don. Scarce, in waste places. 513, 559.

Ratibida columnifera (Nutt.) Wooton & Standl. Occasional in grassland. 310, 374.

Senecio canus Hook. Common in dry grassland. 133, 232, 362, 395.

Senecio vulgaris L. L. A. Mykek 21 (University of Calgary Herbarium).

Solidago decumbens Greene. Common in dry grassland. 397, 428, 510.

Solidago gigantea Ait. var. *leiophylla* Fern. Fairly common in disturbed areas in forests and waste places. 509, 558, 592.

Solidago missouriensis Nutt. Fairly common in grasslands. 361, 463, 478.

Solidago rigida L. var. *humilis* Porter. Rare, tall grass by roadside. 532.

Sonchus asper (L.) Hill. Rare, creek bottom, introduced. 658.

Sonchus oleraceus L. Rare, roadside ditch, introduced. 633.

Sonchus uliginosus Bieb. Occasional, in moist disturbed areas, introduced. 378.

Taraxacum officinale Weber. Occasional, weed of disturbed areas. 119.

Townsendia sericea Hook. Occasional, in dry grassland. 18, 59, 61.

Tragopogon dubius Scop. Frequent, becoming well established in grassland habitat, especially where disturbed. 146.

Xanthium strumarium L. Reported for the area by Bird (1971) but no specimens seen.

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The Blue Jay Bookshelf

THE VIOLATED VISION — THE RAPE OF CANADA'S NORTH. 1972. By James Woodford. McClelland and Stewart, 25 Hollinger Road, Toronto 374, 136 pp. $5.95.

Environmental concerns about the development of northern Canada are increasing, although most Canadians probably remain indifferent. *The Violated Vision* by James Woodford successfully challenges this indifference by attacking past and present government policy (or lack of policy) on several fronts. Most strongly criticized are federal legislation for the protection of the Arctic environment, damage to the environment by mineral exploitation (especially by the oil industry), and the failure of the federal government to recognize the aboriginal and treaty rights of Indians and Eskimos.

The federal government has attempted to control environmental damage in the north by proposing land use regulations (these have not yet been made public) and by Bill C-202, The Arctic Waters Pollution Prevention Act. Of the former Woodford maintains, "There are too many legal loopholes in the Arctic Land Use Regulations to make them effective, even if the government were serious about enforcing them." The drafting of northern land use regulations (NLUR) began in 1969 with the formation of an advisory committee which included representatives of industry and at least six prominent conservationists. Woodford comments, "Evidently the full NLUR Advisory Committee met only once or twice and virtually none of the recommendations made by the conservation representatives were added to the draft Regulations." Essentially the government's environmental program n the north has been to let industry police itself. The situation is further complicated (or simplified from the point of view of government and industry) by the fact that development, conservation and Indian affairs in the north are all handled by one government department, the Department of Indian Affairs and Northern Development. The objectives within this department are frequently in conflict and all too often the conflict is resolved in favour of the developers and to the detriment of the native people and the northern environment. Woodford recommends dissolving the Department of Indian Affairs and Northern Development and distributing its responsibilities among other government departments.

Bill C-202 is criticized because it contains a curious definition of waste (pollution itself is not defined). According to the bill, "waste" is "any substance that, if added to any waters, would degrade or alter or form part of a process of degradation of the quality of those waters to an extent that is detrimental to their use by man or by any animal, fish or plant that is useful to man." Woodford correctly points out that, in law, the usefulness of a particular organism to man may be very hard to establish. The bill perpetuates the unfortunate attitude of technological man that the earth and its life were placed here solely for the purpose of human exploitation and nature is only of value if man can use it in some way. Many conservationists and others believe that this attitude, perpetuated by present governments, is leading us even closer to self-destruction. Now we find it enshrined in pollution prevention legislation.

The book discusses damage to the north by the oil industry in some detail. The greatest immediate threat is damage to the fragile surface of the tundra by seismic exploration. Oil spills, wildcat wells, and the effect of seismic blasting on whales are also discussed. Considering that the industry is only starting operations in the north, its environmental record there is discouraging. Many accidents are mentioned by the author and in the short time that the book has been available, three fuel spills have occurred from broken pipelines and a storage tank at Resolute. Either the oil industry conducts its northern operations with inadequate safety precautions or petroleum technology is not sufficiently developed to cope with temperature changes in the north.

Most northern Indians are covered by Treaties 8 and 11 which guarantee hunting, trapping, and fishing rights (this guarantee has since been broken) as well as reserves in the amount of "one square mile for each family of five, or in that proportion for larger or smaller families." No reserve lands have ever been set aside. No treaties exist between the Eskimo people and the Canadian government.

A federal commission headed by Walter H. Nelson was established in 1959 to review Treaties 8 and 11. It found that about 4,502 Indians were covered by the treaties and that they were entitled to 576,016 acres of land. Since the Indians did not want to live on reserves, the Commissioner recommended that some other means of fulfilling the treaties be found. Specifically he recommended a cash payment of $11,520,320 plus an annual royalty from mineral resources of 1% of revenues. These recommendations were never adopted. Since the treaties have never been fulfilled, the Indian people probably still possess much of the north. We as immigrants have a choice. We can steal the north as our forefathers stole most of southern Canada in the last century or we can develop the north with the approval, advice, and help of the native peoples in some mutually beneficial way. All development so far — oil exploration, mining, oil and gas drilling, and the Mackenzie highway — has been instigated without prior consultation with the native peoples. The white man simply took what he wanted.

In the concluding pages, the author recommends a halt to Arctic development. "A moratorium would allow time for the development of long-range plans: for an ecological survey, for the settlement of the status of the Original Peoples and their rights, for the setting aside of adequate parks and scientific reserves, for the negotiation of fair taxes and royalties or resource production, for study of the best means of retaining Canadian ownership and control over northern resources, and for a Northern Environmental Policy Act. It would also allow time for an assessment of the effects, to date, of resource exploration and development, time for research to determine the parameters of the northern environment, and time to establish administrative and enforcement programs and personnel to control development."

In the current array of books on the environment, there are few Canadian books dealing with Canadian problems. This is an excellent one and should be read by all interested in conservation and the future of this country.—*David H. Sheppard,* Regina.

HOW TO TALK TO BIRDS, and othe uncommon ways of enjoying natur the year round. 1972. By Richard C Davids. Alfred A. Knopf, New York 242 pp. Price $8.25

Do you want to know how to rais moths? Or one of the easiest ways t attract birds to your yard? Or what fox will do when presented with th choice of opossum, live, or dog biscuit for dinner? This book will tell you And if you haven't the initial enthusiasm to want to know these things this book will try to arouse it in you Mr. Davids is, as he says in his firs chapter, a missionary for nature, an his book aims to make converts to th cause of conservation, not by quotin gloomy statistics and trying to scar people into being conservation-minded but by arousing their interest in th world around them, and nurturin a love for it that will prevent th thoughtless destruction that so ofte takes place.

The book is full of interesting anecdotes from Mr. Davids' travels on th continent and in other parts of th world. For instance, he mentions th reaction he got when, at a constructic site in Egypt, he raised his binocula to look at a yellow wagtail. Or his ow reaction when he discovered how the Japanese grew the extra large strawberries he had so enjoyed on a visit to Japan.

Mr. Davids' home is in Minnesota, and he has also lived on the eastern seaboard of the United States. The book naturally deals with the wildlife of those areas, so that many of the animals and birds that he mentions will not likely be seen here. However, his chapter on bird identification for beginning bird watchers is valuable wherever one may live, and his concern for the preservation of natural habitat, especially swamps and wetlands, is one that should be shared by prairie people at the present time.

Some people may feel a twinge of suspicion when they come across a report of the sighting of a flock of Canada Geese within easy shotgun distance of the train in which he was travelling. Mr. Davids grew up on a farm where hunting rounded out the food supply, and he acknowledges the necessity of harvesting game animals. But apart from that, he draws an interesting distinction between hunting game and shooting it, and while he feels that the hunt is probably an instinctive thing with man, the urge to shoot may in most cases eventually be satisfied by the use of a camera.

The author's style becomes a little monotonous if the book is read from cover to cover in a short period, for not everyone will respond favourably to being constantly cajoled and exhorted to do this or that, but most will find something of interest or something to marvel at, no matter where they may dip into its pages. —*Lucy Eley*, Regina.

Letters and Notes

LONGEVITY IN A CAPTIVE SPARROW HAWK

On April 18, 1971 a banded Sparrow Hawk *(Falco sparverius)* died in the home of A. R. Campaner in Surrey, B.C. The bird had been taken in captivity as an adult on or about July 1, 1960 at Yellowknife, near the species' northern limit of its breeding range (Godfrey, *Birds of Canada*, 1966). The bird carried band No. 33-03903 at time of capture and had been banded by W. L. McDonald of Yellowknife, N.W.T. The date of banding of this bird and of its three almost fully feathered clutch mates, was reported by the Banding Data Processing Unit, Migratory Bird Populations Station in Laurel, Md., to be July 24, 1960. This date and that of the day the bird came into the possession of Mr. Campaner appear to conflict. Unfortunately, I have been unable to confirm the date of banding partly because of Mr. McDonald's death on October 30, 1971.

The captive Sparrow Hawk was mostly fed a diet of calves' liver but sometimes ate cooked chicken, pork or beef. The bird liked fresh peas as well as an occasional string of cooked spaghetti and would nibble at a section of orange. When exercising in the garden, it would eat insects, especially grasshoppers, an important part of the diet of many wild Sparrow Hawks. For a week prior to its sudden death, the bird had been fed a solid diet of raw beef.

Band recovery listings for this species received from the Canadian Wildlife Service Banding Office in Ottawa reflect a paucity of records. Only 22 recoveries were listed for Sparrow Hawks banded or recovered in western Canada. The longest known life span of any of the recovered birds was that of one recovered four years after having been banded as an adult in B.C.

At the time of its death, the captive bird discussed here was almost 12 years old. Data on longevity of raptorial birds, even in captivity, are sufficiently rare to be of interest. — *E. Kuyt*, Canadian Wildlife Service, Fort Smith, N.W.T.

GREATER PRAIRIE CHICKEN SIGHTED AGAIN

In the March 1972 *Blue Jay* I reported a probable sighting of a Greater Prairie Chicken *(Tympanuchus cupido)* near Mortlach on December 19, 1971. Although the bird was flying and it was glimpsed only briefly, I believed I had seen enough of the critical characteristics of that species to justify alerting interested persons in the area.

So far as I know the species was not seen again in the area until shortly after 4 p.m., April 16, 1972. At that time my wife and I were driving east on Alternate Highway No. 1 when just about a mile from the Caron corner I noticed a grouse perched on the power line which runs on high poles south of, and parallel with, the road about 50 yards away. Some years ago in the same general area I had seen a grouse similarly perched, but this one was sufficiently unusual to warrant closer examination, which I effected with a new pair of 8 x 40 power binoculars. It was a cloudy day, but reasonably bright.

My bird was most co-operative. Because it faced me on its perch and looked this way and that, I was able to note that its underparts were covered with narrow bars (the Sharptail is mottled), the tail was short and squarecut and black, the head was peaked, and the distinctive face-pattern shown in some texts was well-defined. My bird had a black line running from the bill to the eye and this line appeared to continue at right angles down the neck, and actually would be the black pinnae which I could not distinguish as such at the distance. Light patches on either side of the neck could be seen and presumably were the sites of the air sacs, stated to be orange in colour, now deflated. After I had thoroughly examined its front, the grouse obligingly reversed itself on the wire and I got a better view of its dark square tail and the distinctively barred back. I could see no barring on the tail and that fact, along with the prominent head peak — the comb — and the air-sac patches—led me to believe my bird was a cock Greater Prairie Chicken (or Pinnated Grouse as it used to be known).

Because of the prevalence of Sharp-tailed Grouse *(Pedioecetes phasianellus)* in the area I was concerned lest we lose the Greater Prairie Chicken population there by hybridization so I made some inquiries. (Such a hybrid was listed without comment in the Christmas Bird Count for Raymore, Wayne C. Harris, compiler, appearing in the March 1972 *Blue Jay.*) I received an illuminating reply from Mr. G. Wayne Pepper, Fish and Wildlife Ecologist, of the Saskatchewan Department of Natural Resources, stationed in Saskatoon, who commented, in part, as follows:

" . . . I've been conducting a research study on Sharptail ecology over the past four years at Asquith, west of Saskatoon, and in the duration have collected much of the available literature on prairie grouse . . . Firstly, it is well documented that Sharptails and Pinnated Grouse do hybridize often at the disadvantage of the Pinnated Grouse. Sharptails apparently tolerate Pinnated Grouse on a dancing ground but tend to dominate them on the ground. Because most of the mating on a dancing ground is carried out by one or two dominant males at the centre of the ground it seems that the Pinnated Grouse males get little chance to mate with females of the same species. Perhaps some Pinnated Grouse do become dominant on the dancing ground because from my experience no two dancing grounds ar alike in terms of behaviour of th birds using it.

"I would suspect that the ability o Pinnated Grouse to exist in a given area despite Sharptails would depend on the habitat within approximately one mile radius of the breeding ground Sharptails are better adapted to th short grass, shrubby situations commonly found throughout Saskatchewan because of our climate and grazing practices. Pinnated Grouse apparently have to have large quantities of rank growing tall grass for nesting and brooding.

"Sharptails will eat considerable amounts of grain but can get by in winter on buds and berries of shrubs and trees. Pinnated Grouse apparently must have grain in the winter in Saskatchewan. Consequently, I would think the major limiting factor here was insufficient acreage of ungrazed tall grasses and forbs."

Mr. Pepper went on to note that if a remnant population of Pinnated Grouse (Greater Prairie Chicken) could be positively established, a rescue program could well be considered. Thus encouraged, I spoke to one D.N.R. official who agreed that the first step would be discovery of a population and, at this time of the year (early May) the simplest method would be the location of the dancing grounds frequented by this species. I was allowed to hope that a team of professionals would get on the program right away.—*Frank Brazier*, 2657 Cameron Street, Regina.

DICKCISSEL SIGHTED NEAR BROOKS, ALBERTA

While working in the field on April 20, 1972 I made two unusual observaions. At about 11:00 a.m. I noticed wo Crows attacking a Snowy Owl, a ate migrant for this date. Eventually he Crows forced the owl to land in he bottom of a drainage ditch. Since I was working up and down the field, I stopped at the house and picked up ny binoculars, hoping that the birds vould still be there when I got back. Although I was gone for about 30 ninutes, the birds were still in much he same place so I stopped the tractor o look at them. At this time I saw a eautiful sparrow-sized bird on a fence oost about 25 feet away. The bird eemed unusual and each time it flew rom the ground to the top of the post took a better look at it. It had the rightest yellow breast of any bird of his size that I had ever seen, a V-haped neck stripe similar to that of he Western Meadowlark, and it lackd the horns of the Horned Lark; without the horns the head looked smoother and more streamlined than that of a lark, and it was a dull, faint bluish color. It also had a faint yellow eye stripe. (A small sparrow-like bird on the ground may have been the female.) I watched it for about 10 minutes, then walked down the ditch until the Crows took off. The owl flushed later than the Crows and when it flew, it seemed slightly crippled in one wing.

About three weeks later while looking up the Lapland Longspur in Peterson's *Field guide to western birds* I realized the small bird I had been watching was pictured at the top of the page with the longspur. After reading the description I was convinced the bird I observed was a Dickcissel. Salt and Wilk's *Birds of Alberta* and Sealy's article in the *Blue Jay* (March, 1971) give but one record of this species in Alberta, a male collected near the town of Walsh on June 14, 1940.

I have been back to the site and will continue to look in the hope that I may be able to see these birds again. If I do find them, I will try to get some slides as I have the proper camera equipment. I would in no case even think of killing the bird to prove the identification nor would I point it out to anyone who had this idea in mind.—*Sam Alberts*, Box 729, Brooks, Alberta.

NOBODY TOLD THE ROBIN

Recently my wife and I spent the night at a Bungalow camp at Sunwapta on the way to Jasper. The lady in charge noticed my camera and remarked that I might get some interesting sunset shots from a little lake up the road called Honeymoon Lake. We walked in the short distance from the highway and found a peaceful, beautiful little lake with only three people ahead of us, two young fellows trying their luck with rod and fly and a young lady who was cleaning the one fish they had caught so far.

While strolling around looking for a spot to take some pictures, my wife noticed a robin about fifteen feet up an evergreen making quite a commotion and on a second look we could see that the bird was tangled up in something and could neither get in the nest or fly away. I brought the poor bird's plight to the attention of the fishermen and in less time than it takes to tell the one cupped his hands and gave the other chap a leg up the evergreen to where the branches started. He crawled out on the branch, but it looked as though it would not take his weight so he had to hold on to another branch while he tried to disentangle the robin from a ball of fishing line that she had evidently picked up to help in building her nest. As the chap wasn't having much luck clearing the bird, he called on his pal for a knife and soon got the bird free. Off she went leaving three little ones in the nest one of which had some of the fishing line down its throat. The athletic young fellow pulled this out and returned to earth. We saw the two at the restaurant the next morning and they were able to tell us that they had seen the mother bird return to the nest later. So this story has a happy ending but it made me realize that some frustrated fisherman hadn't thought what he was doing by leaving a mess of tangled line lying around.—*Ed. Reed*, Kindersley, Saskatchewan.

KIT FOX IN SASKATCHEWAN

In reference to your article on the Kit Fox, I mentioned to several people last year that I had seen what I thought to be a Kit Fox in June of 1971, about 12 miles south of Mankota, Saskatchewan. Everyone seemed rather skeptical at the time, so I didn't get too excited over it.—*Larry Kerwin*, Calgary, Alberta.

In late April or early May of this year, I saw a fox with unusual coloration. The location was about three miles east and eight miles south of Eastend, Saskatchewan. It was shortly after that that *The Readers Digest* contained paintings of threatened species. To the best of my recollection the painting of the Kit Fox matched the animal which I saw.—*Jack Wilkinson*, Saskatoon.

Early on the morning of May 30, 1972, five miles south of the village of Woodrow, a cat-sized animal that may have been a Kit Fox jumped out of a ditch about 200 yards from a farmstead and ran into the field parallel to the road and about 50 yards in front of me before disappearing into some trees. It looked like a third-grown ordinary Red Fox but the color appeared a little duller and it had quite a bush tail for a small animal.—*C. H. Shulver*, LaFleche, Saskatchewan.

JOHN WALKER

We have learned with regret of the death of Mr. John Walker of Moose Jaw on July 6 at the age of 55. When Mrs. F. B. Taylor called a meeting in March 1957 to organize a Natural History Society in Moose Jaw, Mr. Walker was elected president; he was instrumental in getting the new society going, and we all know what a successful group it has been.

John Walker was a director of the Saskatchewan Natural History Society from 1958 to 1960. Many of us have happy memories of hospitality enjoyed at John and Muriel's lovely home, 852 Valley View Drive, overlooking the Moose Jaw River.

Mr. Walker, a keen bird watcher from boyhood, kept many records which were invaluable to the Moose Jaw Natural History Society when Leith Knight compiled *Birds of the Moose Jaw area.* He continued to observe and to record sightings of birds for the society until his death.

John will be missed by many in our society particularly by his friends and associates in Moose Jaw. We extend our sincere sympathy to his wife Muriel and to his sisters.

ANNUAL MEETING

The SNHS will hold its annual meeting in the Museum of Natural History, Regina, October 14. 1972. It is hoped that many members will participate. Please see the next Newsletter or write to the Secretary fo program details.

THE SASKATCHEWAN NATURAL HISTORY SOCIETY

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